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Alphabetical Index of Contents.

A denotes Articles. ***A** denotes Illustrated Articles. **Ax** denotes Abstracts and Extracts. ***Ax** denotes Illustrated Abstracts and Extracts.
E denotes Editorials. **L** denotes Letters to the Editor. **L N** denotes Legal Notes. **N** denotes News and Notes.
R denotes Reviews of Books. **P N** denotes Patent Notes. **T N** denotes Trade Notes and Novelties and Mechanical Department.
*** T N** denotes Illustrated Trade Notes.

PAGE.

A

Absolute Measurements in Electricity and Magnetism.... R 331
Accumulator installations, Scott-Sisling system for, W. B. Sisling.... *A 210
Accumulators in France, use of.... L 125
“ Wladimiroff.... *A 36
Acme storage battery car.... *T N 74
“ storage car in New York.... N 632
Actinometer, electro chemical.... N 522
Administration Building, illumination of.... *A 506
Advertising, electrical display.... *T N 154
Aerial rapid transit.... N 271
Alternate current transformers, influence of frequency on the working of, Chas. Steinmetz.... *A 184, 207, 260
Alternating currents, curious action of attraction, Elihu Thomson.... *A 261
Alternate currents of high potential and high frequency.... *Ax 43, *A 65, Ax 88
Alternating current instruments, Whitney.... *T N 541
“ plants, unremunerative.... L 20
“ plants, efficiency of, H. J. Ryan.... A 12
“ system, experiences with.... Ax 280
Alternator, triple-current.... *Ax 143
Aluminum, manufacture of.... L N 97
“ plating.... N 568
American Association for the Advancement of Science.... N 637
American Bell Telephone Co.... L N 274
“ “ “ “ annual meeting of.... A 338
“ “ “ “ exhibit of.... *A 619
“ Electrical Works, new factory for.... T N 128
“ Institute of Electrical Engineers.... N 46, 417, 587
“ Institute of Electrical Engineers, annual meeting of.... N 465, 490, 513
“ Institute of Electrical Engineers, meeting of.... E 502
“ Institute of Electrical Engineers, at the World's Fair.... N 346, 458
“ Institute of Electrical Engineers, official badge and certificate.... N 511
“ patent declared void ab initio.... N 345
“ Street Railway Association.... N 441
Ammeter and milliammeter, Kennelly standard.... N 394
“ new standard, Kennelly.... *A 378
Ampere, N. J.... *T N 395
“ foot table, G. T. Evans.... A 256
Anderson, Sir James (*obituary*).... 464
“ reminiscences of Sir James, A. E. Kennelly.... *A 569
“ strain insulator.... *T N 202
Andrews, D. A., Sr. (*obituary*).... 294
“ W. S.... N 298
Angier & Kennard.... T N 228
Aniline, electric production of.... N 559
Annuaire du Bureau des Longitudes.... R 170
Ansonia Electric Co.... T N 175, 299, 491, 540, 566, 635
“ “ “ exhibit.... *A 621
“ “ “ “ historical dynamos in.... N 458
“ “ “ World's Fair bureau.... T N 301
Archer & Pancoast Manufacturing Co.... N 588
Arc light, Mercury.... N 9
“ lighting and constant potential power service, convertible system of, S. W. Rushmore.... *A 310
“ lights and London fogs.... N 137
Arkansas State University, electrical engineering at the.... N 94
Armature for electro-magnets “non-sticking”.... *A 425
“ , which is the ?.... N 450
Armington & Sims Engine Co.... T N 540
Armour Institute, Chicago.... N 229
Army, no telephones for.... N 421
Atlantic, lighting up the.... N 171
Atmospheric electricity collector.... *Ax 484
At the eleventh hour.... E 84
Automatic transmission on long submarine cables.... L 602
Ayer, J. I.... N 517

B

Badges at the St. Louis Convention.... N 197
Ball & Wood catalogue.... *T N 100
“ “ Co.... T N 398
“ Engine Co.... T N 324
“ “ sales.... T 298
“ engines.... *T N 225, T N 276, 541
“ “ for lighting and railways.... T N 373
Baltimore notes.... 128
Bangkok, Siam—electric railroading at.... N 408
Barclay automatic governor stop.... *T N 72
Barrett's birthday, Prof.... N 622
Battery, “Ajax” dry.... T N 445
“ “Aluminum-iodine” portable testing.... *T N 636
“ grid, “claw”.... *Ax 284
“ Premier-DeMott blue stone.... *T N 199
“ Silvey storage.... *T N 202
Batteries, Leclanche.... T N 75
Battle ship “Illinois,” electricity on.... *A 597
Beaumont variable electric car gear.... *A 338
Belknap motors at the Fair.... *A 508

PAGE.

Bell Company's answer in the Government telephone suit.... L N 464
“ telephone, annulment of patent in Austria-Hungary.... L N 463
“ Telephone Co.'s statement.... N 259
“ “ decision.... L N 588
“ “ litigation.... L N 538
“ “ “ at McKeesport, Pa.... L N 463
Benjamin, Park, disclaimer from.... L 562
Bericht über die Verhandlungen des Internationalen Elektrotechniker-Congresses zu Frankfurt a. M.... R 365
Berlin Iron Bridge Co.... *T N 177, 493, T N 300
“ “ “ Co.'s new catalogue.... T N 542
Berliner patent.... E 164
“ “ Government attack on.... L N 174
“ telephone patent, Government suit to annul the.... L N 217
Bishop Gutta-Percha Co.... T N 72
Black, C. W.... N 367
Blackening of lamp bulbs.... N 458
Bliss armature-cutting press.... *T N 50
“ Co., E. W.... T N 74
“ cutting press.... *T N 225, 420
Block signal system, Watson and Stewart.... T N 539
“Blue-print steal”.... N 490
Boardman, Samuel (*obituary*).... 294
“Bombshell” after all.... N 421
Boston West End road, Sale of.... N 266
“ “ “ “ Status of.... N 559
Brake, Christensen air.... *A 361
“ Elliott.... *A 508
“ for electric cars, Emergency.... N 360
Braider for telephone and other wires.... *T N 397
Brockton and Boston electric railroad.... N 288
Brooklyn, Extending electric roads in.... N 116
“ franchises vetoed.... L N 464
“ Institute, Electrical section.... N 46
“ “ of Arts and Sciences, telephone lecture.... N 119
“ “ of Arts and Sciences, Mr. A. A. Knudson before the.... N 262
“ Trolley system in.... N 213
Brown's alternating motors.... L 486
Brown & Sharpe Manufacturing Co.... T N 468
“ “ “ “ at the Fair.... N 484
Bruch, C. P.... N 125
Brush, Boudreaux anti-friction.... N 568
“ Electric Co.... N 344
“ storage battery patent, suit for infringement.... L N 489
Buda-Pesth, Siemens-Halske conduit road.... N 570
“ “ telephone “ticker” service.... N 357
Buffalo and Tonawanda Electric Railway Co.... N 117
Bunnell & Co. at the Fair.... N 488
“ “ “ World's Fair.... A 573
Buoys at Jackson Park, electric.... N 360
“*Buyer's Reference*”.... T N 378

C

C. & C. Electric Motor Co., in Philadelphia.... T N 469
“ Motor Co.... *A 215
Cable, another South American.... N 125
“ French Pacific.... N 198
“ quick work of the.... N 310
“ rupture.... *Ax 459
Cables, Automatic transmission on long submarine.... L 602
Cabot, J. A.... N 345
Caldwell, E.... N 125
California Electrical Society.... N 441
Cambridge Storage Battery Co. defeated.... L N 538
Canadian Electrical Association.... N 71, 120
“ “ “ second convention.... A 145
“ notes.... T N 26, 76, 378, 614
Canal-Boat propulsion, Electricity for.... N 607
“ mule, Emancipating the.... E 85
Canals, Electricity on.... E 596
Candle power of arc lamps.... N 415
Canton, Ohio, Electric Work.... N 483
“Canvas Jacket” in the West.... T N 492
Carbon filament lamp of 1859, F. L. Pope.... *A 77
Carbons at the World's Fair, Hardtmuth.... *A 576
Carborundum, E. G. Acheson.... *A 228
Carpenter electric cooking utensils.... *T N 176
“ enamel rheostats.... *A 47, 633
“ heaters for a steamer.... T N 199
Case Engine Co.... T N 300
Cawley, George.... N 609
Cell, Weston standard.... *A 355
Central Electric Co.... T N 300
“ power station, Ideal.... *Ax 39
“ station economy, F. B. Crocker.... A 36
Champaign Electric Light and Power Co.... T N 325
Chandler's testimony in the Edison “Feeder and Main” patent suit.... L N 391
Chart for determining the ampere turns of shunt magnets, wire gauge, W. R. C. Corson.... *A 208
Cheap electric light posts must go.... N 422
Chester Light, Water and Ice Co.... T N 470
Chicago and Detroit, connecting link between.... N 219
“ and St. Louis electric railroad before Congress.... N 61
“ “ “ road.... N 87
“ Edison Co.... T N 201

PAGE.

Chicago city electrical inspection department, Work of the.... N 172
“ Electric Club.... 46
“ “ “ meters before the.... N 119
“ “ “ Election of Officers.... N 441
“ Electrical Association.... N 120
“ “ Congress.... E 522
“ “ “ Committees for.... N 119
“ Exhibition.... N 197
“ Lake street electric road in.... N 169
“ Milwaukee and St. Paul railway.... T N 396
Childs, A. E.... N 538
Choking coils.... N 18
Cleat, Hammond.... *T N 518
“ Pass & Seymour, three-wire.... *T N 299
Cleveland, Electric roads in.... N 408
Clocks, Simple system for operating electric, R. G. Brown.... *A 185
Colgate, G. L.... N 589
Collins, W. F.... N 20
Columbia College, Electrical engineering at.... N 147
“Columbia” historic Edison plant.... *A 208
Columbian celebration in St. Louis.... N 444
Columbus celebrations in New York.... A 489
Combination plant for Graham, Va.... N 218
“Comedy” and “Comity” of the courts.... E 409
Commercial Cable Co.... N 320
“ “ at the World's Fair.... *A 455
“ “ Souvenir.... T N 76
“ Electric Co.... T N 152
Commissioner of patents, Suggestions from.... N 173
Compound and variable shunt machine.... L 20
“ wound machines.... L 124
Condenser and high resistance set, Marshall's portable combined.... *A 365
“ in alternate current power distribution, Wm. Stanley, Jr.... *A 423, 449, 471
“ in alternating work.... E 426
Congress, Committees for the Chicago Electrical.... N 119
“ Electrical.... N 84
“ Meeting of the Advisory Council of the Chicago Electrical.... A 98
“ Provisional programme for the International Electrical.... *A 66
Connecticut Electric Light Association.... N 21
“ Legislation in.... N 507
“ new electric railway law.... L N 588
“ street railway commission proposed.... N 169
Consolidated Car-Heating Co.... T N 378
Convention notes.... 253
“ topics.... N 211
Converter, Elkhart.... *T N 101
Copper wire, conductivity of in various dielectrics.... Ax 144
“Corsair” electric lighting plant.... *A 630
Cost of heating cars electrically.... T N 468
“ of steam power with engines of different types.... Ax 316, 341
Country house lighting.... N 308
Crane, Brown portable.... *T N 396
“ Electric jib.... *A 389
Cranes, Pawling & Harnischfeger.... *T N 24
Crinoline, Dangers of.... N 340
Crocker-Wheeler Electric Co.... T N 224, N 323, T N 378
“ Model Factory without shafting.... *A 476
Cross, J. A.... N 20
Current or caloric ?.... E 187
Curtis electric railway motor.... *A 115
“ railway motors in successful competition.... T N 372
Cutler & Hammer.... N 254
Cut-out and Outlet Insulator, P. & S. combination.... *T N 445
“ “Horseshoe” fixture.... T N 562
Cutter catalogue.... T N 300
Cutter's mine socket.... *T N 100

D

Deaths and accidents caused by high tension current.... N 388
Death of Mr. Lowrey.... L N 416
Deck planer, electric.... *T N 372
De Cordova & Co., Alfred.... T N 300
Delaware Hard Fibre Co.... T N 199, 324
“De Magnete,” Gilbert's.... N 49
De Magnete, by Wm. Gilbert, M. D.... *R 69, R 197
Denison model work.... T N 611
De Rycke separators.... T N 176
“ separator in electric light stations.... T N 299
Detroit Electrical Works.... T N 201, 300, 347
“Diamond” Transformer.... *T N 73
“ transformer wiring rule.... T N 152
Dielectric Hysteresis.... A 595
Dielectrics, disruptive strength of.... *Ax 342
Direct-coupled isolated plants.... L 320
Direction of induced currents, A rule for determining the, H. A. Strauss.... A 137
Discharge through gases.... N 662
Discharges, Some experiments with disruptive, A. J. Wurts.... *A 161
Distruptive discharges, A. J. Wurts.... *A 161
“ strength of dielectrics.... *Ax 343
Distribution of potential, G. P. Huhn.... *A 186
Dixon Crucible Co.... T N 74, 178, 394, 420

INDEX.

PAGE.
Dixon Crucible Co. at the Fair..................N 622
D'Odiardi's medical electricity...............T N 102
Donaldson-Macrae Electric Co. ....T N 248
Donodoe, F. E. ....N 315
Drake, Payson and Whittier..................T N 398
Drill, General Electric Company's percussion.. .... *T N 517
Drill, Jones rotary electric...................*A 377
Drop the trolley in the slot .... E 479
Dry steam........ ....T N 325
Duluth, important electrical industry for...T N 154
Dynamo and engine, Riker multipolar marine............ ....*T N 128
“ brush, alloy . .. . N 289
“ Desrosier's continuous current......*A 340
“ for metallurgical work, Oerlikon....*A 356
“ historical, Wood ... .*A 504
Dynamo, how to manage the, by S. R. Bottone.R 197
Dynamo, La Roche alternating..............*T N 565
“ “ direct current..........*T N 491
“ Mather direct-coupled..............T N 52
“ or generator ?.......................L 364
“ *Tenders' Handbook, new*, by F. B. Badt............................ ....R 70
“ Wood's alternating current........P N 46
Dynamometers and measurements of power, by John J. Flather .... .R 148
Dynamos, alternators and transformers, by Gisbert Kapp ....R 417
Dynamos, Easton direct-connected..........T N 346
“ Muncie Electrical Works “Iron-Clad”...............................*A 606
“ steady speed for.. ... .L 219
Dynamotors or direct-current transformers..Ax 465

E

Earth currents, W. Finn.........................A 307
“ “ .... N 380
Eckert, Gen. T. T., chosen President of the Western Union................ ....*N 272
Edgar, H. T......................................N 20
Edison Company, Annual report of the New York......................................T N 127
“ “Feeder and Main” patent, sustained. ....L N 345
“ fixture patents, Recovery for infringement by users denied..............L N 489
“ Illuminating Company of New York..N 562
“ Lamp Patent, Judge Hallett's decision refusing an injunction under......L N 416
“ patent lamp, Suits under............L N 588
“ plant, historic................ ....*A 208
Efficiency of alternating current plants ....L 20
Electric and magnetic fields, Experiments in.Ax 144
“ and magnetic instruments ....N 567
“ Appliance Company....... ....T N 420
“ Appliance Company's adjustable electrolier...............................*T N 325
“ Building, Loan and Savings Association. .... N 562
“ cooking at the St. Louis Electric Club.N 538
“ fire litigation.................... .....N 268
“ Fountains at the World's Fair. T. C. Martin ... .*A 427
“ Haulage in the Rock Springs Coal Mines, Wyoming..............................*A 440
“ heating ....Ax 552
“ “ at Great Falls, Mont........T N 491
“ “ at the Chicago Electric Club..N 538
“ “ system of the American Electric Heating Corporation..*A 585
“ installations ....*Ax 291
“ launch for a Tacoma street car line...N 361
“ launches at the Exposition........ ..*A 438
“ light consolidation in Chicago.... ...N 422
“ Light Convention, Preparations at St. Louis for the...........................N 154
“ *lighting and power distribution*. W. P. Maycock.... ....R 70
“ “ *and power distribution*. Part II. By W. P. Maycock ....R 552
“ “ and ventilation..................E 313
“ “ in churches, St. Francis Xavier's, New York. John McGhie ....*A 204
“ “ in New England, Financial aspects of..... ....E 545
“ “ plant of the “Corsair”... ..*A 630
“ locomotive for the B. & O. ....*A 117
“ machine tools.................... ...E 360
“ manufacture of caustic soda and bleach...... ....*Ax 425
“ power in drift mining.............. ...N 195
“ “ in mills and factories ....*A 215
“ *railway in theory and practice*, by O. T. Crosby and Dr. Louis Bell.... ......R 365
“ railway or railways. *See railways.*
“ railways and electrolysis..............E 409
“ roads, A “strike” at....................N 169
“ “ Long.............................E 164
“ “ Proposed legislation in Connecticut ....N 287
“ safety curtain.................. ....N 325
“ Selector and Signal Company.......T N 221
“ traction in the city of Philadelphia. R. L. Warner..................................*A 286
“ transmission for Moodie's Gold Mining and Exploration Company, Ltd....*A 607
“ vs. steam locomotive.......... ....N 109
Electrical and Mechanical Engineering and Trading Company.........T N 176, *A 414
“ Congress at Chicago, Programme...N 456
“ “ official appointments to ...N 514
“ “ preliminary programme...N 537
“ “ programme .. ..E 59
“ display advertising ....T N 154
“ ENGINEER, THE..N 83, 99, 127, 176, 186, 197, 323, 560

PAGE.
Electrical engineers, Outlook for ....E 578
“ exhibition for Italy..................N 70
“ *experiments*. By G. E. Bonney....R 197
“ furnace .... *Ax 284
Electrical Industries, World's Fair supplement.......................................N 622
“ oscillations, experiments of Sarasin and De La Rive...............*A 195
“ plant in a Denver smelter.... ....T N 635
“ recording meters . ...Ax 143
“ theory. A. L. Arner...............*A 495
“ “ ....L 625
Electrician Directory .. ..N 301
Electricity at the Press Club Fair..............N 494
“ at the World's Fair..................N 194
“ Building at the end of May ... .. A 527
“ “ Commendation of.... ...N 573
“ “ Opening ceremonies .....*A 549
“ “ Present appearance of ...*A 385
“ “ Progress in ....*A 600
“ in mining, Benefits of. John McGhie. ....A 142
“ on the Battle Ship “Illinois”.. .*A 597
“ on the canals................ ....N 564
“ vs. steam ....*A 389
Electrification of gases by friction on metal...N 400
Electrocution, Improvements in.......... .....N 36
Electro-dynamic machinery, Theoretical elements of. A. E. Kennelly...*A 106, 132, 332, 358, 451, 475
Electro-hypnotism in Congress.................N 172
Electrolysis by alternating currents............N 449
“ Metallic diaphragm in.............N 450
Electromagnet, Varley duplex. M. C. Sullivan. ....*T N 75
Electro-Tanning.................................Ax 478
Electrotherapeutic apparatus, Standardizing..A 459
Elevated railways, Horse power required on the New York ....*Ax 288
“ road in Boston.........................N 462
Elevator, Morse-Williams electric.... ....*A 487
Elevators controlled by the Leonard method in the American Theatre, Otis . ...*A 615
Elgin Electric Club..... ....N 323
Elkhart converter.........................*T N 101
“Energy.”................................. 201
Engineering Association of New South Wales, Minutes of the Proceedings..................R 170
Engine, Ball........ ....*T N 225
“ Case automatic high speed ..... . T N 492
“ Dick & Church.....................*T N 221
“ for the Hudson Company's power station, Hoboken, N. J..... ... .T N 562
“ Pittsburgh gas................ ....*A 628
“ Van Vleck disconnective........ ....*A 147
Engines, Harrisburgh Ide and Ideal........T N 50
“ Racine........................... *T N 51
“ Westinghouse ....T N 420
England's Greeting to Chicago.... ....N 465
English workman's time recorder..........*T N 127
Equipping cars electrically prior to shipment .A 482
Equity in patent cases........................P N 71
Eureka Tempered Copper Company at the Fair. ....N 484
Evans, D. E. .... .N 170
Exact adjustment of standards of resistance and the determination of temperature coefficients. E. G. Willyoung..........................*A 6, 32
Execution by Electricity, Instantaneous......N 637
Exhibit notes....... 250
Exit Fake No. 1............ ....N 622

F

Fan motor, De Mott “Turret”.......... .. *T N 443
“ Edison Manufacturing Co.'s new iron-clad battery.............*T N 446
“ W. S. Hill ....*T N 590
“ Novelty Electric Co.'s alternating ....*T N 468
“ outfit, Lundell ceiling......... *T N 494
Fan outfit, H. N. & H..... ....*T N 541
“ Menominee ....*T N 611
Farmer, Prof. M. G.......... ....*A 519
“ Moses G., portrait facing page......... 543
“ Prof. Moses G...........................E 545
“ Prof. M. G. in Chicago... ....N 550
“ Prof. Moses G. (*obituary*).............. 564
“ -Wallace reminiscences.................L 319
“Feeder and Main” patent sustained.......L N 345
“ “ “ patent...................E 360
“ “ “ suit decision... ....L N 390
“Ferracute” at the Fair.......... . ... A 438
“ cutting press, index.... ....*T N 276
Field hammer mold..........................*T N 299
“ magnet frames, wrought versus cast iron for.............. ....Ax 232
Filament planer, Goebel's......................*A 148
Filaments, The Lodyguine process of preparing ....N 331
Fires caused by electric currents, Statistics of, G. S. Boudinot...... ....A 617
Fiske's depression position finder...... .....*A 591
Flagpole, “deadly”.............................E 59
Ford-Washburn cars.................. T N 202
Fort Wayne Electric Co.'s exhibit and special lighting at the World's Fair...*A 434
“ “ plants.............................N 560
Fountains, Trouve's luminous..................N 501
“ World's Fair electrical ....E 84
“ “ “ electric.. ....A 504
Franklin Electrical Society lectures...........N 169
Freighting at Thomaston, Me., Electric......*A 212
Furnace, Moissan electric................ ...Ax 478
“ Moissan's experiments with the electric........................ .. ..N 630
Fuse metals, Action of continuous and alternating currents on........ ... .*Ax 509
“ wire and its use . ...*T N 296

PAGE
G

Gallup, Captain Albert (*obituary*)................ 21
Galvanometer, Deprez D'Arsonval..........*Ax 530
“ driftless ballistic....... ....L 44
“ method of controlling the ballistic, A. L. Arner.............*A 259
“ Recent improvement in D'Arsonval.............. ....*Ax 363
Galvanometers, Recent improvements in D'Arsonval... ....*A 388, 410
Garbage “destructors” and electric lighting..N 592
Gas and Electric Light Commissioners of the Commonwealth of Massachusetts, Eighth annual report...................................R 510
“ engine for electric lighting, Caldwell..*T N 223
“ “ in electric lighting.................E 631
“ lighting burner, “Parke pendent”....*T N 51
Gear, Beaumont variable electric..............*A 338
Gelatinous electrolyte for storage batteries, Paul Schoop...... ....*A 478
General Electric ....E 268
“ “ Co.............................T N 611
“ “ at the World's Fair..........A 436
“ “ Co., Attitude of the..........E 188
“ “ “ charges of larceny against ....L N 463
“ “ “ first annual report......A 368
“ “ “ new apparatus.......*T N 297
“ “ “ of London, World's Fair exhibit...............*A 524
“ “ “ sued for infringement of a converter patent..L N 439
“ “ Co.'s duplex sinking pump*T N 492
“ “ “ report.............. ..E 379
“ “ “ World's Fair folder.....N 576
“ “ finances............................N 488
“ “ Launch Co......... ......*T N 350
“ “ model arc plant..............*A 483
“ “ plant of the Indiana Hospital for the Insane..........*T N 99
“ “ sale of Edison local stocks...N 538
“ “ switchboard, new.........*T N 23
“ “ World's Fair exhibit.... ..T N 347
“ Incandescent Arc Light Co......... T N 467
“ “ “ Co.'s new arc lamps...*T N 153
“ “ “ Co.'s St. Louis exhibit..*T N 277
Generators and motors, Western Electric multipolar........... ....*A 452
“ compound with variable series shunt ....L 170
German Electrical Engineers, Union of.......N 249
“ wires and cables at the Fair.........*A 618
Giant Electric Motor Co ....T N 75
Gilbert, M. D.... ....R 69
Gilbert's “De Magnete”........... ......N 49
Glasgow, Electric lighting in....................N 325
Godfrey, J. W.................................*N 394
Goebel..E 110
“ case in St. Louis ... .L N 514
“ “ revived as a defense in St. Louis.L N 391
“ defense rejected .. ..E 187
“ incandescent lamp litigation.........L N 95
Goebel's incandescent lamp and filament planer ....*A 148
Gordon, J. E. H. (*obituary*)............. 273
Gould's electric pumping plant..............T N 367
Gould triplex pumps................... ..T N 200
Government time service at the naval observatory, World's Fair ....*A 574
Graphite as a lubricant.........................L 511
“ at the World's Fair...... .... T N 302
“ bearings for electrical machinery..T N 469
Greeley & Co.'s display at the Fair...........*A 551
Green, Dr. Norvin (*obituary*)................... 174
“ and Benjamin.........................*A 376
“ electric railway patents................N 123
“ “ “ “ Acquisition of by the General Electric Co..*A 141
“ Was he a Goebel ?........... . ... ..E 139
“Grimshaw” at the World's Fair............ N 458
Gubernatorial candidate, Ideal........... ..N 63

H

Habirshaw insulation .... T N 277
Hall's Phenomenon....... ....N 477
Hamblin, H. W. ....N 367
Hamilton, E. J...................................N 367
Handbook of electrical testing, by H. R. Kempe ....R 70
Handbuch der Elektrotechnik, by Dr. Erasmus Kittler.............. .... R 552
Hanger board for arc lamps, Dow..........*T N 350
Harrisburgh Ide and Ideal engines..........T N 275
Havemeyer building lighting plant.. ....T N 302
Head, Francis ....N 538
Heater, “C. C.-H. Co.” electric..............*T N 348
“ electric........ .. ..Ax 560
“ Goubert feed water................*T N 518
“Heating and ventilation” ....N 144
Heating, electric......................... .....Ax 568
“ cars electrically, cost of.......... T N 635
“ new method of electric.............Ax 570
“ O'Neil-Brown system of electric....*A 381
Heisler Electric Co .... .T N 201
“ long distance series system of electric lighting, W. S. Horry. ....A 262
Heliograph in New York ....N 458
Helios lamps in Baltimore......... ....T N 542
“ lamp in the West ....T N 325
Henry, J. C.......................... ....*A 344
Hibbard, A. S......... ....N 170
Hickock plant, Harrisburgh, Pa. ....T N 73
Hülfsbuch für die Elektrotechnik, by C. Grawinkel & K. Strecker...... .... R 148

PAGE.
High frequency currents, Janet's experiments .... *A 284
" " " physiological and other effects of, Nikola Tesla.........A 122
" " electric discharges, A. A. C. Swinton. ....A 282
" " " " experiments with, A. A. C. Swinton..............*Ax 88
Hipp, Dr. M. (*obituary*)........................* 609
Hoist, General Electric Co 's 4-Winch .....*T N 397
" Johnston portable iron................*A 440
Horse power of a thunderbolt.............L 170
Hotel Waldorf, electric lighting plant........*A 594
House of Refuge electric lighting, Glen Mills, Pa.,..................*A 561
Houston, E. J.......................... N 196
" Prof. E. J.........................*A 518
" Stanwood & Gamble ....T N 277
How it all happened..........................N 259
Hub-friction clutch pulley and cut-off coupling ....*T N 469
Human trolley..................................N 608
"Hunting" parallel alternators................N 380

I

Illumination of the Russian war ships, electric ....*A 632
"Incandescent arc" lamp as a rival to the incandescent lamp, A. Noll. A 292
" " lighting......................E 285
Incandescent lamp from a commercial standpoint.......................Ax 237
" " litigation, Edison *vs.* Beacon ....L N 274
" " " in Boston.....L N 70
" " " ....E 139
" " " ....L N 21, 95, 120, 149, 174, 188, 294
" " situation.........E 426, L N 464
Incandescing filaments, preparation of ....N 196
Index of current electrical literature, synoptical....................................N 638
Indiana Hospital for the insane, General Electric plant in..............................*T N 99
Influence of magnetization on E. M. F.........N 593
"Impedance"..................................Ax 488
Insulated electric conductors, J. B. Williams, M. D.........................A 33, 56, 85, *A 163, 206
Insulation resistance of cotton and silk covered wires.—A correction .... N 63
Insurance and electric light and power......Ax 234
Interior conduit catalogues.................T N 540
International electrical congress at Chicago, suggestions for........L 196
" " " papers for. N 610
Inventors' record, 21, 49, 71, 98, 125, 147, 178, 198, 219, 274, 294, 295, 322, 366, 393, 418, 442, 466, 490, ... .512, 539, 564, 587, 610, 634
Iron in electromagnetic apparatus. Laminated, T. D. Lockwood, *A 5, 27, 57, 82, 108, 133, 160, 183
Is lightning a car arrester ?....................L 196
Isolated electric lighting plants, installation of ....*A 68
Italy electrical transmission in................N 171

J

Jackson, Prof. D. C.............................N 538
Jacobs & Moore electric display system..*A 448 T N 469
Japan Electric Light Association..............N 536
Jeffery, D. H., (*obituary*)....................... 273
Jenney Electric Motor Co. .... T N 277, 300
Johns, H. W., Manufacturing Co. at the World's Fair ....A 438
Johns Hopkins University, electrical engineering at..N 632
Joint resistances, simple method of calculating. W. C. Ramsdell..............................A 593
Judge Hallett's decision refusing an injunction under the Edison Lamp Patent............L N 416
"Jumbo"..*A 454

K

"Kerite" at the Fair...............................*A 523
Kerite cables in the North River.............T N 202
"Kerite" World's Fair exhibit..............T N 324
Khotinsky, Capt. A., De.........................N 367
"Kodak" plants in electric railway work.....N 413
Kreidler, W. A........................N 170, 510

L

L. P. & D. Transmitter........................*T N 444
Laminated or divided iron and other metallic masses in electromagnetic apparatus. T. D. Lockwood.....*A 5, 27, 57, 82, 108, 133, 160, A 183
Lamination in electrical apparatus............E 35
Lamp, Carbon filament for 1859. F. L. Pope. *A 77
" case, Oconto.......................L N 562
" Clark arc..............................T N 221
" Colby's new incandescent...........*P N 588
" Edward Weston on the incandescent from a commercial standpoint.......Ax 292
" Helios alternating current arc......*T N 301
" Kester Atwood arc...................T N 226
" "Incancescent arc" as a rival to the incandescent. A. Noll..................A 292
" litigation, Oconto, Wis.............L N 514
" new Westinghouse...................T N 51
" new Westinghouse stopper..........*A 108
" new Westinghouse.....................L N 220
" "Novak" Incandescent...............N 424
Lamp, Packard six candle power..........*T N 635
" Prentiss incandescent......................N 34
" sales. No discrimination to be permitted in...............................L N 120
" socket for alternating and continuous currents, Moore regulating. D. McF. Moore...................................*A 306
" socket, Moore regulating.............T N 324
" Stern incandescent.....................T N 126
" Sunbeam...................................T N 470
" Von Der Kammer incandescent........*A 281
" Voss incandescent.......................T N 464
" Westinghouse...........................E 211
Lamps, Blackening of incandescent............N 258
" converting incandescent into Geissler tubes...N 376
" General Incandescent Arc Light Co.'s new.......................................*T N 153
" Mosher arc for direct and alternating circuits..................................*T N 234
" Most economical age of incandescent *Ax 363
" New Sunbeam incandescent. ....*A 375
" Recent improvement in stopper...... *A 376
Latest electric light............................N 121
Launches at the World's Fair, Electric........N 405
Leonard & Co., H. Ward ....T N 492
Life saver for electric cars.......................N 624
Light and other high frequency phenomena. Nikola Tesla.............*Ax 531, 553, 579, 603, 626
Lighting a given space, How to figure on......N 632
" by phosphorescence..................E 318
" by phosphorescent tubes...........*Ax 318
" plants, installation of isolated electric......................................*A 68
" the biggest building in the world. T. C. Martin...................................*A 303
" the biggest building in the world. ...N 405
" the White City..........................*A 404
"*Lightning*" *album*...................................N 301
Lightning and Thunderstorms.................. N 424
" arrester. Wurts.........................T N 22
" arresters, Commercial success of non-arcing metallic. A. J. Wurts........A 13
" protection, Notes on. A J. Wurts. *A 255
Lignes de Transmission Electrique. By Lazare Weiller and Henry Vivarez...................R 321
Lindsay, W. E.....................................N 345
Lineman's delight, Pfluger's.................*T N 24
Lithia Spring Railroad Company.............T N 420
Little & Co.....................................T N 25
" Electric Construction and Supply Company..T N 422
Locomotive, Electric, *vs.* steam..................N 109
" for suburban traffic, Electric....*A 507
" Heilmann Electric..................*A 482
London underground electric road, Finances of ....N 218
Long distance transmission from Snoqualmie Falls, Wash.......................................*A 400
"Long Distance" yarn from Europe...........N 487
Low resistance for railway ground return.....L 411
Lowrey, Grosvenor P. (*obituary*)...............* 419
Luminous discharges...........................Ax 123
Lundell battery motor, new..................*T N 22
" exhaust fan outfit.....................*T N 612
" motor, Design of.........................L 124

M

Machine tools, electric.........................*A 351
Mackaye spectatorium.........................T N 373
Mackie, Robb.....................................N 315
Magnesia sectional covering, interesting test of ....*T N 323
Magnet on mercury, action of an electric current in displacing a...............................N 9
Magnetic club.....................................N 46
" curve tracer, Ewing's...................E 596
Mail car in St. Louis and other cities.........*A 37
" service in St. Louis, electric..............N 87
" transportation in cities, electrical........A 60
Mangin and Schuckert projectors.............*A 289
Mantle, Lee..N 272
Manufactures and Liberal Arts Building, lighting the, T. C. Martin.............................*A 303
Marquand, Skehan & Co.........................T N 76
Mason Regulator Co............................T N 176
Massachusetts Board of Railroad Commissioners, 24th annual report..........R 386
" Electrical Engineering Co., testing department..............T N 349
" Mechanical and Electrical Association ....N 518
McDevitt, W ....N 224
McGill University, electric engineering plant ....*A 447
" " engineering and physics at ....N 262
McKinley protection for motormen ....N 49
Mechanical and electrical analogies, F. Bedell and A. C. Crehore..............................A 85
Medical electricity, D'Odiardi's.................T N 102
Meek, B. F., Jr.....................................N 170
Menominee Electrical and Mechanical Co...T N 590
Mercury, resistance of...........................N 568
Meston, A. W. (*obituary*) 510
" ⅛ h. p. single reduction motor....*T N 372
Metal working, development in electric........ A 15
Meter, ideal electric, W. G. Stratton...........A 496
" Illig electric.................................*A 270
" Scott's sliding scale electric, W. B. Sisling....................................*A 30
" Pentz-Reckenzaun electric, J. A. Pentz and A. Reckenzaun ....*A 500
" Pentz-Reckenzaun.........................T N 516
" Stanley alternating current...........*A 334
Meters, electrical recording...........Ax 91, 122, 143
" sliding scale electric......................E 85
Method of correcting the regulation curves of generators, G. L. Thayer.......................A 140
PAGE.
Mexico, electric railways for....................N 14
Mica Insulator Co...............................T N 275
Milwaukee, changing a short steam road to electricity..N 608
Mine pumping at Duryea, Pa, electric. ....*T N 50
Mineral industry................................T N 126
Mining hoist, General Electric. ....*T N 126
" scheme, Ohio electric......................N 421
Moissan's experiments with the electric furnace..N 630
Monopoly ?..E 335
Montreal Electric Club.........................N 169
" notes...................................T N 300
Morals of corporations.........................*Ax 231
Motor, "G. E 800" Railway....................*A 529
" action of the Tesla........................L 170
" and emery grinder, Lundell..........*T N 199
" and tool in one.............................E 263
" Brown single phase alternating current ....*A 259, L 386
" circuits, 500 volt.......................T N 76
" Curtis box railway......................T N 378
" " electric railway....................*A 115
" Deri alternate current.....................*A 470
" design alternate current...................L 273
" design of the Lundell.................L 45, 124
" Feldkamp................................*T N 276
" fixed closed coils in alternating.........L 125
" General Electric, for narrow gauge tracks ....*T N 349
" Joel alternating...............................N 568
" Meston alternating, A. W. Meston.....*A 282
" " ⅛ h. p. single reduction . *T N 372
" New Lundell battery................. *T N 22
" non-synchronous for ordinary alternate currents, C. E. L. Brown..............*A 134
" Perret....................................*T N 540
" Stanley and Kelley two-phase alternating ....*A 401
" speed, influence of field strength on....L 439
" Storey "solenoid" for direct machine driving.......................................*A 267
" Stow flexible shaft........................*T N 590
Motors at the Fair, Belknap........................*A 508
" for alternating currents, F. H. Leonard, Jr...*A 271
" for ordinary alternating currents, non-synchronous, E. Arnold. . ...*A 279
" for ordinary alternating currents, non-synchronous, L. Gutmann...........A 312
" Meston single reduction.............*T N 372
" non-synchronous single phase alternating, H. A. Wagner......................*A 334
" operating on single phase alternating current circuits, E. E. Ries and G. J. Scott..A 323
" single phase alternating...................L 272
" " " " W. A. Turbayne, ...*A 497
" Storey's direct driving..................*T N 445
Movable sidewalk at the World's Fair....*A 571, 599
Muncie Electrical Works......................T N 638
" Ind., Citizens' Street Railway, with natural gas as fuel, L. W. Collins.......*A 623
Municipal electric lighting at Topeka, cost of. A 357
" " light plant at Peabody, Mass. ....N 367
" electric lighting, cost of.............N 197
" plant at Titusville, Pa, giving up..N 319
" versus private plants, H. A. Foster. A 309
Munson Belting Company at the Fair.........*A 623

N

National Brotherhood of Electrical Workers..N 296
" Electric Light Ass'n......................N 191
" " " " Convention in St. Louis, Papers to be read at the. N 152
" " " " Proceedings of the Sixteenth meeting .... A 243
" " " Convention, Railway arrangements for.....N 71
" " Manufacturing Co........... N 538
" " " " asks for a receiver. N 562
Naval observatory at the World's Fair.......*A 574
Neftel & Marsh.................................T N 515
Neuchatel, Switzerland, Electric power transmission at..N 163
Newark car house fire...........................N 361
" electric line, Transfer of.................N 289
New England notes....T N 25, 76, 102, 127, 178, 296, 326, 374, 467, 470, 494, 517, ... .542, 566, 618, 638
" " Wide-reaching trolley consolidation in ....N 213
New Haven and West Haven street railway power station, A. C. Shaw.................. *A 111
New Jersey, Another large trolley scheme for. N 218
New London Electric Club.......................N 46
New Orleans electric railway, A. L. Johnston *A 406
" " More electric cars for...............N 118
New York Central & Hudson River Railroad World's Fair Engine..............N 470
" " Central Railroad.................T N 325
" " City, underground conduits and conductors.............................Ax 241
" " Electric Club, Dissolution of......N 70
" " Electrical Repair Co ....T N 612
" " " Society.....N 45, 119, 465, 538
" " " " Lecture on Electro-Therapeutics.........Ax 514
" " " " Telephone meeting............N 175
" " " Works......................*T N 201
" " " " railway appliances for.........*T N 152

PAGE.

New York notes....T N 26, 52, 76, 126, 128, 226, 296, 326, 373, 374, 398, 417, 422, 446, ...470, 515, 542, 565, 589, 613
New York's electrical subways, W. Maver, Jr., ...*A 1, 28, 53, 80
Niagara Falls, Future city of..........*A 321
" light and power contracts..........N 561
" Power Company..........N 610
" Utilization of..........N 64, Ax 90
Noise made by some trolley cars..........N 61
Non-arcing motor, Lundell battery..........T N 23
Nutley's idea of the proper thing..........N 561

O

Oerlikon dynamo for metallurgical work...*A 356
O'Neil-Brown system of electric heating.....*A 384
Orange Mountain, Trolley on the..........N 315
Original papers on dynamo machinery and allied subjects, J. Hopkinson..........R 70

P

Paine, C. McL..........T N 373
Paiste, H. T..........T N 300
Paris underground electric road..........N 570
Parker, J W..........N 367
" & Co..........T N 611
Partrick & Carter Co..........T N 220
" " pocket buzzer..........*T N 350
Patent declared void, *ab initio*, American....N 345
" Office scandal..........L N 538
Patents, foreign and American..........E 360
Pelton water wheel governor..........*T N 516
" wheel at the Fair..........*A 599
" wheels, Regulation of for electric power transmission..........T N 467
Pennsylvania, Long trolley road for..........N 194
Peoria, Ill., New electric railway power house N 417
" railway power house, Destruction of..N 87
Perrine, Dr. F. A. C..........N 293
Peru Elec. Mfg. Co..........T N 100
Philadelphia, Electric traction, R. L. Warner.. ....*A 286
" Engineering Works, Limited.T N 611
" New electric railway in..........N 118
" notes..... T N 25, 76, 102, 154, 178, 202, 296, 374, 397, 422, 467, 470, 492, ...516, 566, 613
Phillips Insulated Wire Co..........T N 201
Philosophy of Individuality of the One and the Many. By Antoinette Brown Blackwell....R 486
Phipps, C. W..........N 367
Phosphor making by electricity..........N 9
Physiological and other effects of high frequency currents. Nikola Tesla..........A 122
Pittsburgh Electric Club..........N 465
" " traction..........N 14
Platinum, Price of..........*Ax 268
Poles, right to collect city fees for..........N 415
Police telegraph, Improvements in the New York..........N 19
"Polyphase" presumably preferable..........L 562
Pope, Read & Rogers..........N 468
Porter, H. T..........T N 25
Position finder, Fiske's depression..........*A 591
Potential indicator, Tice-Lintner.......*T N 74, 636
Potter, J..........N 170
Power plant at the World's Fair..........*Ax 194
" station, An ideal central..........*A 16
" " of the New Haven and West Haven street railway. A. C. Shaw..........*A 111
" transmission for central stations..... Ax 238
" " from the economic standpoint..........Ax 235
" " schemes abroad, Electric.E 10
Prescott, G. B., Jr. (*obituary*).......... 197
Programme for the International Electrical Congress of 1893..........A 66
Providence, Rhode Island, as an electric railroad centre..........N 315
Pump, Chase condenser..........*T N 199
Pumps and hydraulic machinery..........T N 685
Push-Button and wall switch, Klein.......*T N 421
Put-In-Bay & Southwestern Electric Railroad Co..........*A 528

Q

Queen & Co..........T N 101
" " at the Fair..........*A 505
" Co.'s exhibit in the Electricity Building..........N 458
"Queen" apparatus at the Fair..........N 621
Queen measuring apparatus..........*T N 349
" " instruments of precision.*T N 222

R

Radial cars in Boston..........N 213
Railroad and Engineering Journal, change of name..........N 487
Rail, Stillman..........*A 266
Railroad, Long electric, in New Jersey..........N 462
" Put-In-Bay & Southwestern Electric..........*A 528
Railroads and electrolysis..........E 359
" Day of elevated electric..........E 164
" Electric, J. C. Henry..........A 336
" in Ohio, Long Electric.......... Ax 193
" State regulations of electric..........E 380
Railway 24-foot gauge electric..........N 266
" and lighting plants combined, C. J. Field..........A 38
" and lighting stations, C. A. Cooley...A 86
" baggage cars, Electric..........N 507
" Citizens' Street Railway of Muncie, Ind., with natural gas as fuel, L. W. Collins..........*A 623
" conduit, Griffen electric..........*A 559
" " Perkins elastic..........N 229

PAGE.

Railway crossings..........A 38
" " in Canada..........L N 463
" developments at Troy, N. Y..........N 508
" Elevated electric for Paris..........N 39
" " " in Baltimore..........N 483
" Equipment Co..........T N 127, 530
" " at the Fair..........N 435
" extension in Chicago..........N 337
" extensions in San Francisco..........N 87
" Extensive network in New York's suburbs..........N 530
" Extensive system for the Jersey coast ....N 580
" Figures in Massachusetts..........N 169
" financing in Rhode Island..........N 169
" First electric in New Orleans, A. L. Johnston..........*A 381
" for Texas..........N 530
" ground return, Low resistance for...L 411
" growth electric..........T N 97
" " electrical..........N 62
" Grütsch & Mürren electric..........*A 117
" interests in Brooklyn consolidation..A 39
" large electric networks..........E 522
" " " system for Indiana....N 608
" Lebanon, Pa..........N 39
" Legislation in Connecticut..........L N 463
" " " electric...N 387
" " in New York, Proposed..N 288
" Liverpool elevated electric, H. Scholey..........*A 165
" Milan electric..........N 14
" motors, Trouble with..........N 608
" Mt. Vernon electric..........*A 116
" Muncie-Coles Surface Contact Electric ....*A 480
" No satisfactory bid for the New York underground..........N 19
" patents, Green electric..........N 123
" power plant, Designs for a suburban ....*A 314
" power station of the New Haven and West Haven, A. C. Shaw..........*A 111
" Rock Creek, Washington, D. C., P. A. Draper..........*A 264
" St. Louis-Chicago electric..........L 151
" " mail car..........*A 37
" Sleet wheel..........N 38
" South London electric..........N 254
" speeds, High..........E 479
" Starting the Liverpool elevated electric..........N 137
" track sprinkling and cleaning..........N 62
" transactions in the South, Street....N 361
" Trial trip of the Intra-Mural..........N 446
" Trolley in recent snow storms..........*A 60
" " roads for rural New York....N 39
" " victory in Philadelphia....A 37
" Union and Chester & Media Electric, ...*A 481
" Wheless Electric System..........*A 460
Railways, Chicago & St. Louis electric railroad before Congress..........N 61
" Maximum speed on electric, Chas. Steinmetz..........A 13
" or tramways?..........E 380
" travel in Brooklyn, Figures of..........N 61
Rapid transit situation..........N 87
Reflection of electric waves..........N 501
Regulation curves of generators, Method of correcting, G. L. Thayer..........A 140
Regulator for constant current motors, Henry's ....*A 593
Relative advantages of concentric and double cables, N. E Eden..........A 56
Reliance Gauge exhibit in Electricity Building ....*A 601
" gauges at the Fair..........N 576
Rheostats, Carpenter, Enamel..........L A 47
Rhode Island, Trolley extension..........N 266
Ries improved universal base regulating socket ....*T N 278
" isolated plants..........T N 24
Riker multipolar marine dynamo and engine ....*T N 128
River Power at White Hills, Col..........N 421
Rope Gearing..........N 478
Rose Polytechnic Institute..........N 566
Rotation of the magnetic Field, Chas. Steinmetz..........A 34
Rule for determining the direction of induced currents, H. A. Strauss..........A 187
Rutland Electric Light Company vs. Marble City Electric Light Company..........L N 439

S

Salamander wire..........T N 300
San Antonio Water Works, operating by electric motor..........*A 399
San Francisco street railway extensions.....N 87
St. Louis convention and its outlook..........E 240
" " list of attendants.......... 253
" " transportation to..........N 175
" Electric Light Convention, preparations for...N 45
" " " " ....N 120
" electrical development in..........E 240
" Electrical Exchange..........*T N 302
" new isolated plant for..........T N 199
" notes.......... 226, 443, 492
Sargent, Frederick.......... N 293, 443
Sargent's work for World's Fair..........N 345
Sawyer-Man Company's motion denied.....L N 514
" Electric Co..........T N 301
" lamp case in the Supreme Court ....L N 489
Scheffler, F. A..........N 294, 367, T N 470
Schieren belt, large..........T N 277
Screw-Driver Knife, "A. B. C."..........*T N 423

PAGE.

Scott-Sisling system for accumulator installations, W. B. Sisling..........*A 310
"Scribners," World's Fair..........N 197
Search light projectors..........*A 289
" lights and projectors, Ward..........*T N 637
Shall we store current or caloric?..........E 187
Shawmut fuse wires..........T N 201
Short Electric Railway Convention..........T N 349
Shultz Belting Co..........T N 51, 100
Sidewalk at the World's Fair, movable..........*A 571
Siemens & Halske apparatus, sales of......T N 101
" " railway contract..........N 559
Signaling system, "long distance," transfer.*A 333
Silvey storage battery..........*T N 203
Sleet wheel instead of tallow..........N 38
Sliding contact trolley..........N 62
Smashing lamp globes at Far Rockaway......N 87
Snoqualmie Falls, Wash., Long distance transmission from..........*A 400
Socket, Cutter's mine..........*T N 100
Southern Electric Co., of Baltimore..........T N 613
" notes.......... 202, 374, 614
Sowing the wind and reaping the whirlwind ..E 452
Speed-Counter for dynamo shafting..........*Ax 560
Splice, "Tech"..........*A 506
Springfield, Ill., electric light and steam distribution plant, L. W. Collins..........*A 327
Spunk..........N 378
Standard Electric Signal Co..........T N 366
" Paint Company..........T N 636
Standards in medical electricity..........E 453
" of resistance and temperature coefficients, E. G. Willyoung..........*A 6, [illegible]
Stanley and Kelley's Associates, credit to...L N [illegible]
" transformers..........T N [illegible]
Starkenberg, Felix..........N 314
Statue of Liberty..........*A 19
Steady speed, in a generator..........L 273
Steam distribution plant, Springfield, Ill., L. W. Collins..........*A 327
" power, cost of..........E 313
" " cost of with engines of different types..........Ax 316, 341
Steinmetz or Faraday right?..........L 94
Stern & Silverman..........T N 201
Steward Mfg. Co..........T N 373
Stirling Company..........N 562
" boilers..........T N 566
Stockton, Mr. F R., as an electrical litterateur.N 262
Storage battery, present status of..........Ax 361
" batteries in central stations.....E 10, A 14
" cars in New York, Waddell-Entz....*A 408
Stowell's reminiscences..........L 411
Street car advertisements..........N 344
" " travel in Philadelphia, figures of...N 86
" Hood, Cutter's "Boulevard"..........*T N 611
" lighting by private versus municipal plants, H. A Foster..........A 309
Strowger automatic telephone exchange system, H. M. Underwood..........*A 11
Stuart, Mayor..........T N 396
Submarine cable laying, theory of, G. W. Littlehales.....*A 155, A 183
" cables, automatic work on long...L 511
Submarine Cables, Chart of, by Paul Gacottey and Maxime Mabyre..........R 417
Suburban Underwriters' Association..........N 196
Subways for electric wires in New York....T N 153
" New York's electrical, Wm. Maver, Jr. ....*A 1, 26, 53, 80
Sunbeam incandescent lamp..........*A 375
" Incandescent Lamp Co..........T N 541
Sun spots and magnetic storms..........L 364
Sutton-Steele Electric Manufacturing Co....T N 566
Switch and Rheostat, General Electric Co's., automatic..........*T N 612
" C-S automatic..........*T N 515
" " flush automatic..........*T N 467
" " flush key..........*T N 324
" "E. E. & S." snap..........*T N 101
" " voltmeter..........*T N 396
" Cutter's voltmeter..........*T N 542
" Slocum automatic door..........*T N 398
" test of the Fitch automatic electromagnetic..........T N 590
" Thomson multiple contact..........*A 107
" 2,000-h. p. Ajax..........*T N 347
Switchboard, General Electric..........*T N 23

T

Tariff and electric railway material..........N 172
Taylor Electric Light, Gas and Power Company. ....N 625
Telautograph, Gray..........*A 283
Telectroscope..........*Ax 485
Telegraph among the Michigan farmers.....N 87
" Field vibratory..........*A 195
Telegraph litigation, lottery case..........L N 174
Telephone, Another..........E 313
" at Liverpool..........T N 612
" Cable, Irish Sea..........*A 424
" companies, New competition......N 173
" exchange system, Strowger, H. M. Underwood..........*A 11
" First "gun"..........N 254
" Field's Bifilar..........*A 567
" infringement case, First..........L N 346
" Is this a non-infringing?..........A 312
" lines and their properties. By William J. Hopkins,..........R 510
" lines, Diagonal running of..........N 380
" lines, Static charges on metallic, F. J. F. Schwartz..........A 474
" litigation..........E 188
" mileage in the United States...T N 325
" Ness..........T N 468
" Opening of the long distance service between Boston and Chicago..Ax 172
" patent, Government suit to annul the Berliner..........L N 217

PAGE.
Telephone, Press Opening, Bell ..... N 506
“ Railway ..... N 187
“ rates in Missouri ..... N 261
“ Reminiscences of early days, F. E. Kinsman ..... *A 472, A 498
“ repeater, Field ..... *A 33
“ suit, McKeesport ..... L N 514
“ “ticker” service ..... N 281
“ “ticker” service, Buda-Pesth ..... N 357
“ transmitter, Edison electrolytic ..... *A 283
“ “ Bloomer ..... *A 281
Telephones, March 7, 1893 ..... L 218
“ New ..... E 263
Telephonic Newspaper, Buda-Pesth ..... N 387
“ newspaper service at Buda-Pesth ..... N 602
“ transmission of music between New York and Chicago ..... N 254
Telephony, The K-R law ..... Ax 171
Telephotos, Boughton ..... N 220
Tele-typewriter tournament ..... N 198
Temperature coefficients, determination of, E. G. Willyoung ..... *A 6, 32
Temple of telephony ..... *A 483
Temporary aberration ..... L 171
Tesla, Nikola ..... N 125
“ experiment, Apparatus for performing. A 408
“ lecture in St. Louis ..... *A 248
“ polyphase patents ..... L N 562
Tesla's high frequency work ..... E 35
“ latest work ..... E 521
Testing coal by electricity ..... T N 636
“ set, “Acme” portable ..... *T N 589
Text-Book of Experimental Engineering. By Rolla C. Carpenter ..... R 170
The Benjamin and Green stopper lamps ..... *A 376
Theoretical elements of electro-dynamic machinery, A. E. Kennelly ... *A 106, A 182, *A 332, 358, 451, 475
Theory, Electrical, A. L. Arner ..... *A 495
Thermal storage for central stations ..... Ax 242
Thomaston, Me., Electric freighting at ..... *A 212
Thomson electric upsetter ..... *A 549
Thomson Electric Welding Company, World's Fair exhibit ..... *A 526
Three-wire patent sustained in England ..... E 139
Time recorder, English's workman's ..... *T N 127
Titusville, Pa., giving up its municipal plant .. N 319
Tools, Electric machine ..... *A 351
Topeka electric lighting, Cost of ..... A 357
Tower of light in Electricity Building ..... *A 546
Towing by magnetic adhesion ..... *Ax 567
Townsend, H. C ..... *Ax 441
“Tramway,” Origin of ..... N 482
Transformer experiment, Curious ..... *A 616
“ frequency ..... E 263
“ What constitutes a? ..... L 320
Transformers, General Electric ..... *T N 371
“ New Stanley ..... Ax 91
“ Recent improvements in ..... E 285
“ Weather test of ..... *A 208
Transmission of power, Long distance ..... Ax 236
Transmitted Word, The. By W. J. Keenan and James Riley ..... R 417
Trolley, Allen ..... *A 383
“Trolley buzz” ..... N 608
Trolley car has some rights ..... N 315
“ cars have right of way ..... N 218
“ car, Spillman-Scranton ..... T N 462
“ extension in New York City ..... N 14
“ line for three counties ..... N 142
“ new Allen ..... *A 625
“ on the Erie canal ..... N 197
“ patent suit in New Haven ..... L N 489
“ “pivotal” Boston ..... T N 588
“ roads, Effect of, on New York Ferries .. N 14
“ victory in Philadelphia ..... A 37
“ wire cut-out, Hutchins' ..... N 608
“ wires in New Jersey, Right to string. L N 468
“Trolley wires” need not hinder firemen, J. S. Brown ..... A 140
Truck, Fulton ..... *T N 299
Trusts, Mr. Harter on ..... N 142
Two queries ..... L 124

U

Underground conduits and conductors in New York City ..... Ax 241
United Electric Improvement Co ..... T N 420
University of Nebraska, electrical engineering at ..... *A 583
“ of Wisconsin ..... N 195
Users free from molestation ..... E 479
Utica Mfg. and Supply Co ..... T N 103

V

Vacuum tube phenomena ..... N 452
“ tubes, excitation of ..... N 357
Valve, Stannard electric ..... T N 396
Van Depoele trolley patents ..... P N 441
Varley duplex electromagnet, M.C.Sullivan *T N 75
Ventilating a club billiard room ..... *T N 97
Voltaic cell, by Park Benjamin ..... R 365
Vulcanizing process for preserving and strengthening poles, etc ..... Ax 233

W

Waddell-Entz storage cars in New York ..... *A 408
Wallace, W., and his contributions to the electrical industries, W. J. Hammer. *A 103, 129, 157, 179
“ and his contributions to electrical industries ..... L 364
“ dynamo in Washington in 1878 ..... L 294
“ Farmer reminiscences ..... L 319
Was Green a Goebel? ..... E 139
Waterhouse, Gamble & Co ..... T N 76
Wattmeter, moisture, gas and dust proof, Thomson recording ..... *T N 177
Waterhouse, new Kelvin engine-room ..... Ax 288
Wessels, E. J ..... *N 272
Western notes, T N 25, 52, 76, 102, 128, 154, 178, 200, 226, 275, 326, 374, 421, 467, 470, 491 ..... 492, 565, 566, 614, 635, 636
“ Union ..... E 188
“ “ operators ..... N 320
“ “ Telegraph Co., liability for delay of message ..... L N 610
Westinghouse blue prints, alleged theft of ..... N 587
“ cars for Ottawa, Canada ..... N 559
“ Company enjoined ..... L N 21
“ Electric and Mfg. Co, annual report ..... A 488
“ electric railway work ..... T N 290
“ report ..... E 502
“ stopper lamp ..... *A 108
“ *vs.* General Electric Co. Suit to enjoin the use of oil insulated converters ..... L N 417
“ World's Fair exhibit ..... T N 100
Weston Standard Cell ..... *A 355
“ standard station instrument ..... *A 269
Wheel of Chicagoan dimensions, Electric .... T N 102
Wheeler, S. S ..... *Ax 196
When nature lets loose ..... L 170
Where breezes blow ..... *A 577
Whittier and electricity ..... N 36
Williams, James Bowstead (*obituary*) 464
Wilson & Jackson ..... T N 126
“ Fremont ..... T N 22
Windlass, Eddy Self-Locking ..... *T N 448
Wing & Co. at the Fair ..... *A 577
Wire and its manufacture, Paper insulated ... *A 412
“ and wire rod mills and combination .... T N 76
“ gauge chart for determining the ampere turns on shunt magnets, W. R. C. Corson ..... *A 208
“ Sycamore ..... T N 325
Wires, under current stress, Vibration of ..... N 496
“ and cables at the Fair, German ..... *A 618
Wiring for Electric Light in Buildings, General specifications of. By R. A. Cummings ..... R 417
“ of Buildings for electric lights ..... Ax 478
“ rule, “Diamond” transformer ..... T N 152
Wood's trolley splicer ..... *T N 324
Woodruff & Co., C. E ..... T N 422
Work of the pioneer ..... E 139
World's Fair, additional electric railway facilities ..... N 435
“ “ Alotting space in Electricity Building ..... *A 62
“ “ arc lighting ..... N 437
“ “ at the ..... E 596
“ “ briefs ..... N 229
“ “ closed on Sunday ..... N 457
“ “ Department 385, 404, 427, 454, 483, 503, 523, 546, 571, 597, 618
“ “ Electrical Exhibitors 436
“ “ electrical fountains, Inaccurate representations of ..... N 94
“ “ Electrical Lectures ..... N 290
“ “ Electricity at the opening of ... *A 457
“ “ Electricity Building ..... T N 199
“ “ exhibits, Classification of ..... N 261
“ “ grounds and buildings, Detail electrical work on ..... *A 214
“ “ hospitality ..... N 527
“ “ hotels, Electricity in ..... T N 300
“ “ lighting ..... *A 118
“ “ notes ..... N 550
“ “ Opening ..... N 439
“ “ Space at the ..... E 59
“ “ Sunday opening ..... N 577
“ “ telegraph exhibits ..... N 271
“ “ Terminal charges ..... T N 99
Wrought versus cast iron for field magnet frames ..... Ax 232

X

Xavier's, Electric lighting in, St. Francis. John McGhie ..... *A 204

Y

Young Hopeful and the Trolley ..... N 483
Young Men's Institute, New York ..... N 9

Z

Zeublin, J. E ..... N 272

AUTHORS.

Acheson, E. G 227
Adams, A. D 232
Ahearn, T 560
Anthony, W. A 170
Armstrong, C. G 291
Armstrong, E. A 231
Arner, A. L 259, 495
Arnold, E 279
Barnes, E. A 504
Bartol, N. W 195
Bedell, Frederick 85
Bell, Louis 238
Benjamin, Park 562
Boudinot, G. S 617
Bradley, C. S 236
Brill, J. A 482
Brophy, William 234
Brown, C. E. L 134, 259, 386, 486
Brown, J. S 124, 140, 196, 278, 320
Brown, J. W 151
Brown, R. G 185
Brown, W. H 241
Burke, C. G 511
Burstyn, M 289
C., H. S. A 109
C., L. W 214
C., W. H 20
Chesley, W. S. & Co 219
Clayton, J. C 71
Collins, L. W 327, 623
Conservative 218
Corson, W. R. C 208
Cooley, C. A 86
Crehore, A. C 85
Crocker, F. B 36
Cuttriss, Chas 602
Dahl, Olaf 124
Denison, J. F 20
Dixon, Jos., Crucible Co 511
Dodge, W. C 294
Draper, P. A 264
Eden, M. E 56
Emery, C. E 316, 341
Evans, G. F 256
Ewing, J. A 605
F., G. S 124
Field, C. J 16, 38, 39
Finn, W 307
Forbes, George 64, 90, 242
Foster, H. A 309
Gautherot 14
Genung, N. H 362, 388, 410
Gutmann, L 312
H., R. J 510
Hammer, W. J 103, 129, 157, 179, 364
Haskins, C. D 91, 122, 143
Hassan, M. W 364
Heap, D. P 19
Henry, J. C 336
Henshaw, F. V 364
Hering, Carl 363
Hertz, J. H 608
Horry, W. S 262
Huhn, G. P 186
Jenkins, S. B 563
Jenks, W. J 171
Johnston, A. L 381, 406
Kelly, J. F 125, 273, 439
Kennelly, A. E 106, 182, 332, 358, 438, 451, 475, 569
Kinsman, F. E 472, 498
L., H 609
Lee, C. T *482
Lemp, Herman 411
Leonard, F. H., Jr 271
Le Pontois, Leon 485
Littlehales, G. W 155, 182
Lockwood, T. D 5, 27, 57, 82, 108, 133, 160, 183, 196
Low, G. P 478
Lundell, Robt 45
M., G. B 504
MacFadden, C. K 552
McGhie, John 142, 204
Marple, L. E 562
Martin, T. C 308, 427
Matthews, C. P 509
Maver, Wm., Jr 1, 28, 53, 80
Meston, A. W 282
Moler, G. S 560
Moore, D. McF 308, 448
Myers, H. C 283
Nemo 20
Noll, Augustus 293
Owens, R. B 583
P., F. L 386
P., G. M 95
Palmieri, L 484
Parkhurst, C. D 530
Pentz, J. A 500
Pope, F. L 77
Preece, W. H 171
Pumpelly, J. K 361
Ramsdell, W. C 598
Reckenzaun, Anthony 500
Rideal, S 478
Ries, E. E 323
Rimington, E. C 123
Royce, F. P 15
Rushmore, S. W 310
Ryan, H. J 12, 459
Sanford, Fernando 144
Schloss, N. L 320
Scholey, H 165
Schoop, Paul 478
Schwartz, F. J. F 474
Scott, G. J 323
Shaw, A. C 111, 480
Sheldon, L. M 170
Sisling, W. B 30, 210
Sorley, C 361
Stanley, William, Jr 125, 423, 439, 449, 471
Steinmetz, Chas. P 13, 34, 184, 207, 260, 342
Sterling, R. H 230
Stilwell, L. B 235
Stowell, Chas 319, 411
Stratton, W. G 496
Strauss, H. A 187, 625
Sullivan, M. C 75
Swinton, A. A. C 88, 282
Tesla, Nikola 42, 65, 88, 122, 531, 558, 579, 603, 626
Thayer, G. L 140
Thomson, Elihu 261, 272
Townley, Calvert 237
Turbayne, W. A 497
Underwood, H. M 11
Van Nuis, C. S 347
Wagner, H. A 334
Ward, G. G 602
Warner, R. L 286
Wheeler, S. S 351
Williams, J. B 33, 56, 85, 163, 206
Willyoung, E. G 6, 32, 44
Wilmot, T. J 602
Wolcott, Townsend 94
Work, J. L 439
Wurts, A. J 13, 161, 265

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NEW YORK'S ELECTRICAL SUBWAYS.—I.

BY

Wm Maver Jr.

I.—INTRODUCTORY.

WHEN, in February 1890, I was preparing the paper which I had the honor of reading before the American Institute of Electrical Engineers, on "The Practical Working of the Electrical Subways of New York City"[1], I was well aware that the general opinion of the electrical public, more especially that portion of it engaged in the business of electric lighting by high potential currents, was that no successful system of underground electrical subways, short of a tunnel, perhaps, could be devised. I, therefore, took particular pains to state clearly the exact construction and condition of the subways in question and of the conductors within them; the difficulties which had been and which were to be overcome, and the results accomplished.

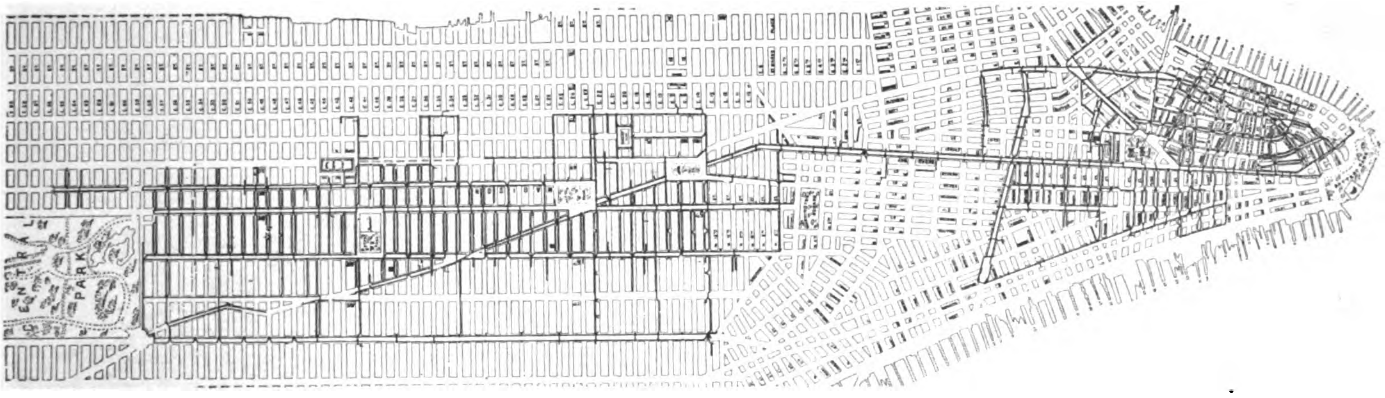

Fig. 2.—Map Showing the Location of the Edison Underground Circuits in New York City.

It is my purpose in this article to give a more detailed illustration and description of the route of the electrical subways of this city, than appeared in the paper mentioned, and of the route and character of the electric circuits, more particularly of the electric light circuits; the type, of cable used; the "distribution" methods employed; the question of gas in the subways, etc.; together with various items of possible interest connected with the practical operation, electrically and mechanically considered, of the subways, during the past five years.

It is generally known that the, so-called, high potential electric light subways and those assigned to telephone and telegraph circuits are of the "drawing in and out" type, and that the "Edison" conduits are of the solid, or permanent, type. The former admits of drawing cables into or out of the ducts, or of drawing in additional cables up to the capacity of the duct, as desired. The latter, on the contrary, does not. A conductor when once placed in position remains until it may be lifted bodily out of its trench. It is obvious that where flexibility is required and especially where many different companies are to be provided with facilities, as in New York City, a "drawing in and out" method must be employed.

II.—ROUTES AND METHODS.

The routes of the "high potential" subways are shown in map, Fig. 1; those of the Edison conduits in map, Fig. 2; those of the telegraph and telephone in map, Fig. 3. The entire electrical subway system south of Worth street is shown in Fig. 4. With but few exceptions, the telegraph and telephone subways are placed on opposite sides of the streets to those of the high potential subways.

There are 70 miles of high potential subways in this city. Of the telegraph and telephone subways there are 45 miles. Of the Edison conduits there are 160 miles. In all 275 miles.

The material of the various subways is mainly wrought iron; but cast iron, cement, creosoted wood, etc., are also employed, as more specifically mentioned in my Institute paper. The ducts range from two to four inches in diameter. There are in all 1,312 miles of ducts in these subways, exclusive of the "Edison" conduits, of which there are 160 miles. The ducts are divided into two classes, termed, respectively, trunk and distributing ducts. These, as the names imply, are alloted to "through" and "way" circuits, respectively, further reference to which will shortly be made.

Access to the "drawing in and out" conduits is obtained by means of man-holes, placed at suitable distances apart, usually about 200 feet. These man-holes are of brick, laid in concrete cement. Entrance to the man-holes is made through a cast iron head, set on the brick-work, and which is provided with heavy double cast iron covers. The manholes average five feet in width and from five to ten feet in depth.

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[1] See The Electrical Engineer, March, 1890.

Access to the Edison conductors is obtained by surface boxes placed at convenient distances apart. These boxes also have an inner and outer removable cover.

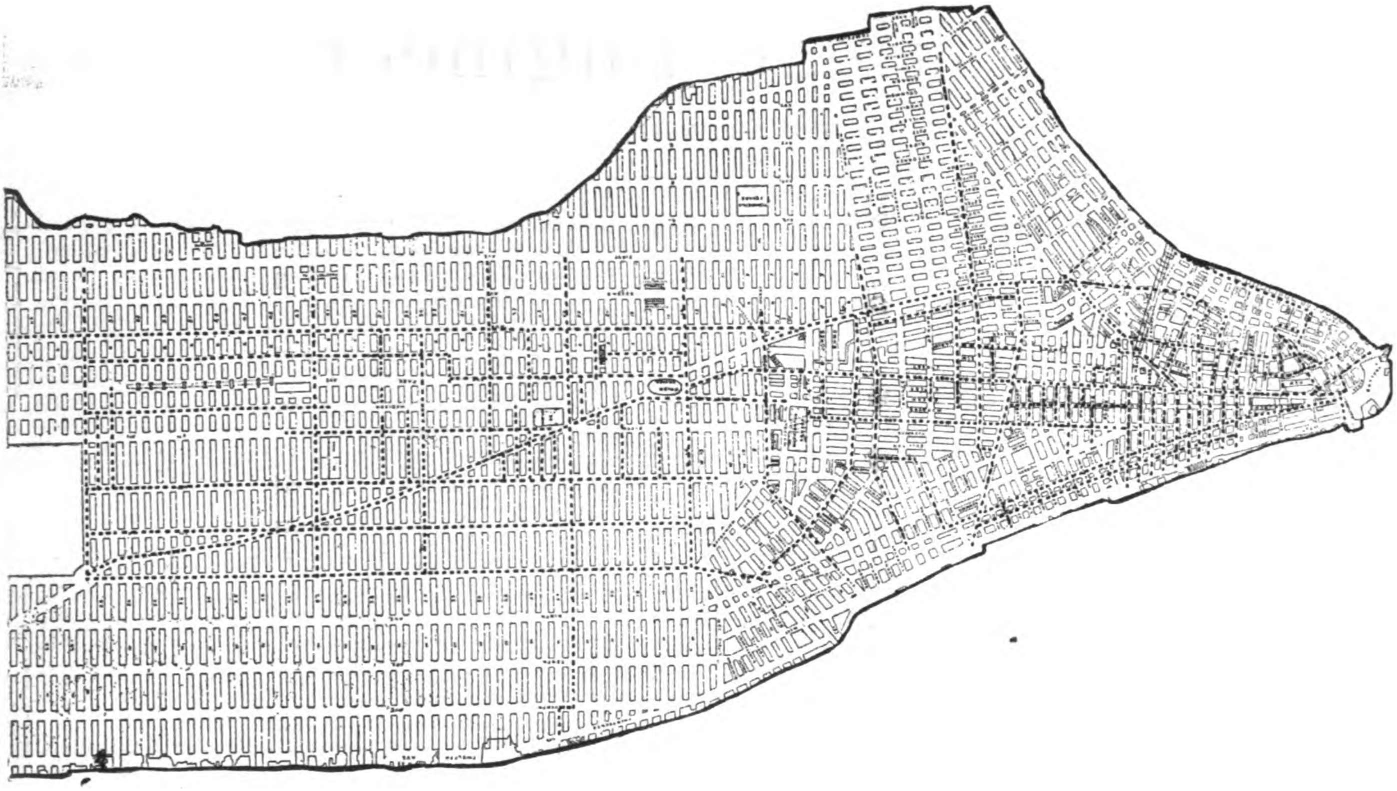

FIG. 1.—MAP SHOWING THE LOCATION OF THE UNDERGROUND ELECTRIC LIGHT CIRCUITS IN NEW YORK CITY.

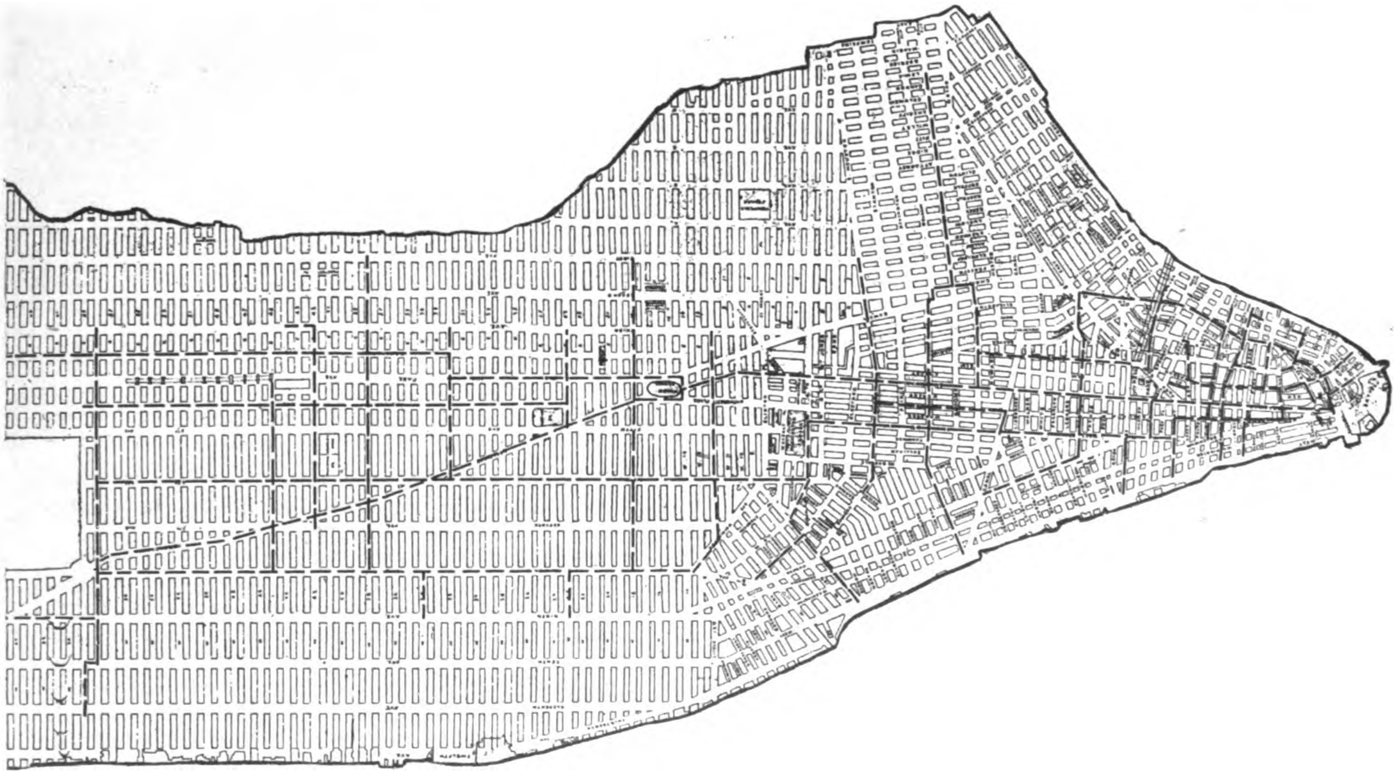

FIG. 3.—MAP SHOWING THE LOCATION OF THE UNDERGROUND TELEGRAPH AND TELEPHONE CIRCUITS IN NEW YORK CITY.

III.—WROUGHT IRON DUCTS.

In all the recent subway construction work done in New York, wrought iron pipe has been used, that material having been found to give the most generally satisfactory results as regards flexibility and strength. Thus far the iron pipes have not been found to introduce any marked electrical complications. Of course, it is essential, to avoid "throttling," to place both legs of alternating circuits in the same duct. Rough tests have indicated that losses due to self-induction, etc., are about three times greater when the conductors of such circuits are in separate ducts than when in the same duct. In the case of telephone circuits it is well known that the transmission is retarded by placing the conductors underground, due to the increased electrostatic capacity of the cables.

The wrought iron pipes are laid in hydraulic concrete and are covered by a row of two inch creosoted planking, to protect them from pick axes, crow bars, etc., in subsequent excavations of the streets. This covering has been found sufficient in almost every instance. On one occasion only has it failed, namely, when a contractor, in sinking an iron bar to serve as an "anchor" for a derrick, forced a way through one of the ducts. These wrought iron pipes are from 18 to 21 feet in length, about one quarter inch in thickness and weigh from 5½ to 8 lbs. per foot, depending on the diameter. The pipes, before leaving the works, are dipped in a preservative formed of a mixture of asphaltum and other ingredients, which is allowed to drain off, leaving only a thin coating inside and out. This mixture speedily dries and does not soften again under the ordinary temperatures met with in the subways, and thus the coating does not impede the drawing in or out of cables.

The pipes in the trench are connected together by coup-

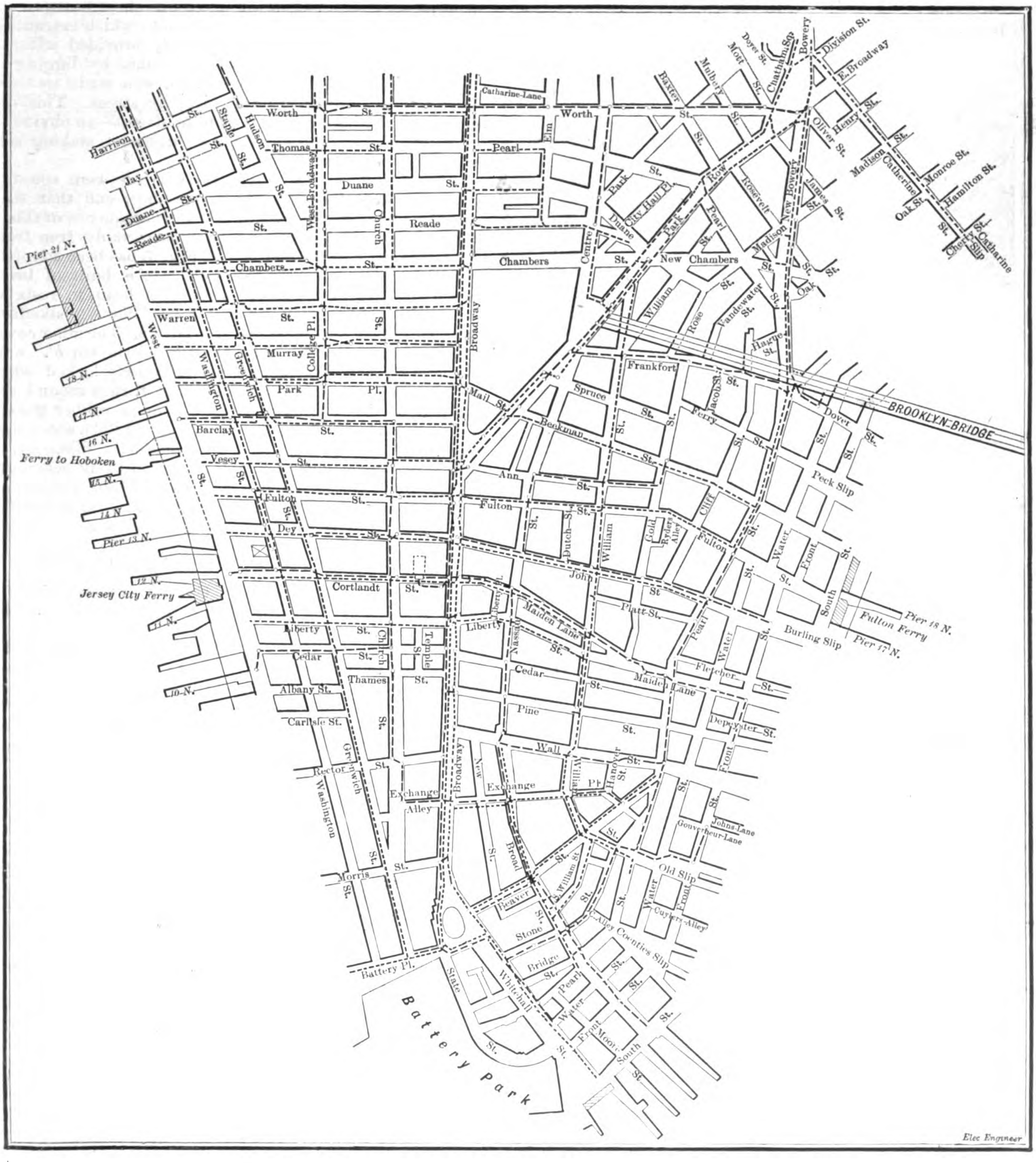

FIG. 4.—COMPLETE SUBWAY MAP, LOWER PART OF NEW YORK CITY.

lings having tapering or vanishing threads. The tapering threads are of great utility in facilitating the work of connecting up the pipes.

IV.—OBSTRUCTIONS IN THE DUCTS.

It is, of course, evident that great care must be taken, in constructing the subways, to remove any substances from the pipes which would be at all likely to act as an obstruction to rodding the ducts or to drawing in cables. In the hurry and the bustle that naturally attend the building of subways in the busiest streets of a large city, however, it is almost too much to expect that many miles of ducts could be laid without some obstructions being found in them afterwards. To minimize the difficulty it is customary to inspect each pipe before it is connected in its place.

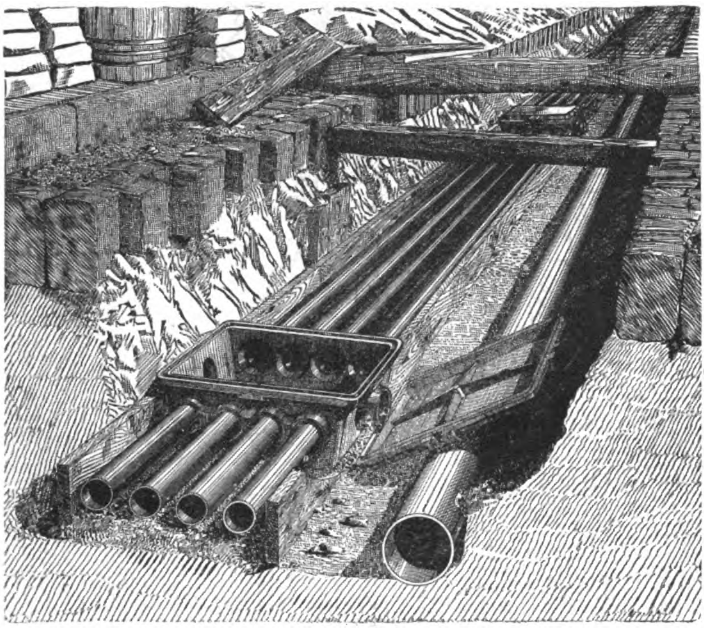

FIG. 5.—OLD FORM OF DISTRIBUTING BOX.

Some of the obstructions found in the New York subways have been of a rather curious nature. In one instance a mandrel was picked up; in another an umbrella, etc., Cement and stones, have, of course, been the most frequent causes of obstruction. In several instances the tools employed in the work of removing obstructions have had to be especially designed to meet the requirements of each case. On more than one occasion the nature or form of the obstruction has been ascertained by taking an impression of it on a suitable matrix pushed along the duct for the purpose.

V.—TRUNK AND DISTRIBUTING DUCTS.

The trunk, or "through," ducts are laid at the bottom of the trench and are not accessible between man-holes. There are no distributing ducts in the telegraph and telephone subways, distribution being made from the regular man-holes. In the case of the Fire Department circuits, the terminals of the cables are brought up to a box placed on the street lamp posts at desired intervals, thereby greatly facilitating necessary changes of circuits. Where lamp posts are not available, the terminals are led into a tubular box, about the size of an ordinary hydrant, on the curb of the street.

The distributing ducts of the electric light subways are placed as near the surface of the street as practicable; being generally from one and a half to two feet below the street level. Access to the distributing ducts between man-holes is now had by means of surface boxes placed at intervals of 50 feet along the route of the ducts. One of the boxes first used for this service, in connection with the wrought iron conduits, may be seen in Fig. 5. It is an iron box about 1.5 foot long and one foot deep. On its end and sides, holes, or spigots, are arranged. The distributing ducts run into the end holes. When it is required to make a connection with a cable in a distributing duct, what is termed a "subsidiary" is laid from the nearest of these boxes to the lamp post or basement of a building into which entrance is desired. These boxes were originally provided with an iron cover, and access to them was obtained by digging up the street. Subsequently, an addition was made to these boxes which raised them flush with the street. This did away with the need of digging up the streets—an obviously objectionable proceeding—for the purpose of making side connections with the cables.

It was found, however, that these boxes were speedily filled with deposits from street washings, and that they settled more than was desirable. In consequence of this a form of surface distributing box, measurably free from these defects, shown in outline in Fig. 6, has been adopted. It is virtually a miniature man-hole. It is built of brick on a foundation of cement. A cast iron head, H, rests as indicated, on the brick walls. It has, like the standard man-hole, outer and inner cast iron covers. The inner cover *c* is held down by the screw bolt *b* and the bar *b*¹. *c*¹ is the outer cover. The inner cover is securely locked when the box is not in use. A curved flange *f*, runs around the cast iron head. The inner cover lies on a rubber gasket resting on this flange. To carry off any surface water that may obtain entrance, a pipe P, two inches in diameter, is dropped from the curved flange to a blind drain below the foundation of the box. This box is about two feet square. The distributing and subsidiary ducts are arranged virtually as described in the case of the original box.

VI.—CAPACITY OF THE SUBWAYS; CIRCUITS, ETC.

The subways in New York City have a capacity for 45,000 miles of telephone and telegraph conductors, and for 5,000 miles of high potential electric light circuits approximately. There are at present about 23,000 miles of telephone and telegraph conductors in the ducts. There are 600 miles of high potential cables employed in the operation of 132 electric light and power circuits. Of these, 88 are continuous current and 44 are alternating current circuits. The conductors of these circuits carry current for, approximately, 3,300 arc lamps and for 80,000 incandescent lamps. The length of these circuits varies from 1 to 14 miles. It may be noted that the tendency is towards longer circuits. On this account, while there are at present more miles of electric light cables than there were one year ago, there are fewer circuits. The maximum electromotive force employed in the arc light circuits is about 3,500 volts. There does not seem much

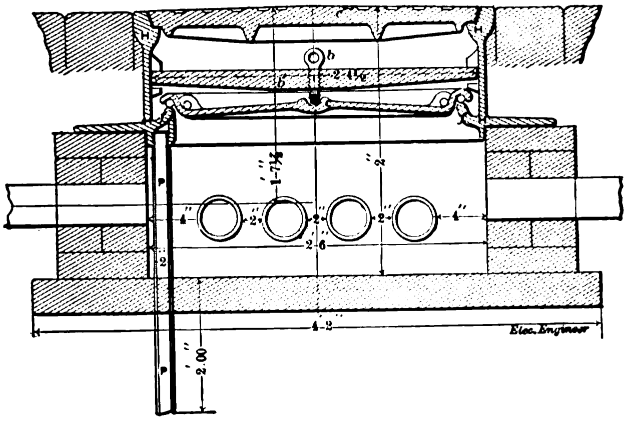

FIG. 6.—NEW FORM OF DISTRIBUTING BOX.

reason to doubt that the majority of the electric light cables in the subways could withstand a pressure of at least 6,000 volts, continuous current.

The ducts of the New York subways are occupied by six different electric light companies, and six different telegraph and telephone companies. In several instances all of these companies occupy ducts on the same section of a given street. No specific districts of the city have been allotted to any given electric light company. Access to the subways to any given company is obtained by mutual arrangement or otherwise; the ducts having been assigned as called for. Tenants obtain access to the subways upon application to the Subway Inspectors who hold the keys of the manholes and surface boxes.

LAMINATED OR DIVIDED IRON AND OTHER METALLIC MASSES IN ELECTROMAGNETIC APPARATUS.—I.

BY

Thos D Lockwood

Dr. James Prescott Joule.

Every one who is familiar with electromagnetic or induction apparatus of nearly any kind, must have observed the wellnigh universal practice of dividing in some way the iron and sometimes other massive portions of such apparatus. We may state this proposition more broadly, by saying, "the iron, and in many instances the other metal portions of such apparatus, exclusive of course of the wire coils." We need not at present discuss the why and wherefore of the practice, but will content ourselves with calling to mind several familiar instances.

Consider the well-known "shocking" induction coil of the street electrician, and recall the fact that its core is made up of fine iron wires; and then further call to mind that the violence of the shock is modulated by a brass tube which is pushed in over the core or pulled out from the core, to weaken or strengthen the shocking currents to be administered to the victim and customer. In this case, note that the core is divided into wires, while the brass tube is not even divided by a slit; why? Because in the core we desire to prevent parasitic currents, while in the tube we desire to employ such currents. Many electromagnets also, we observe, have their cores halved or quartered, at least for a part of their length.

We have doubtless seen electromagnet coils wound on sheet-metal spools of iron, copper, or brass, and these have worked satisfactorily; but if we have in our early days tried to make such spools, and use them after we have made them, we have found that the power of the magnet was very small; and then later, too late often to be useful in that emergency, we have learned that there was a small but radical difference between the metal spools we *saw*, and those we *made*, in that the former were slit from end to end, while ours were not. We can remember also that in the early pictures of the Gramme ring, and the descriptions accompanying them, it appeared that the iron core thereof was composed of iron wire or rod; and that the core of the Brush machine armature was slitted and slotted into quite a number of fantastic configurations. And later, on the advent of the heavy current induction coil calling itself multifariously a secondary generator, a transformer, a converter, or even an exhorter, we know that laminated cores reached their apotheosis.

It seems therefore to have been accepted as a truth from far back times, that it is a good thing to divide the otherwise solid metal parts of electromagnetic appliances, and especially such metal parts as are made of iron. A closer observation of these divisions shows that the divisions are always made in a special direction with reference to the direction of the coil windings; and that direction is in a plane normal or perpendicular to the said winding.

Now, although, as I have said, makers and users seem to have concurred that the division of cores and other parts of apparatus is a good thing, yet it is likely enough, notwithstanding the luminous and voluminous record of what has been done in this connection, and why it has been done, that the number of those who could give an intelligent reason for lamination, and its direction, would be much smaller; and that the number of those who are acquainted with the genesis and evolution of the lamination is smaller yet. There is however no valid reason why all who read The Electrical Engineer should not know to whom this great feature in construction and operation should be attributed; and if, as often proves to be the case, it should turn out that the idea occurred to several persons at about the same time, then there is no reason why we should not weave our respect into a blanket mortgage, broad enough for all concerned. Aside from the meretricious advantage of the mere knowledge of to whom the honors of discovery are due, there is also, I conceive, great interest attaching to the story of the progress of any useful idea, especially when it concerns electrotechnics; and, finally, it is a good idea to have at our disposal a considerable amount of information on the same subject, all in one place, for ready reference.

The great reason for laminating or dividing cores and other metal portions of electromagnetic apparatus, is (to use a Stocktonism), the discouragement of eddy or parasitic currents. This is the principal reason, because it is the reason which applies both to iron and to other metals. Wherever changes in electric currents are occurring, or wherever changes in magnetism are occurring, there is also, of course, a tendency for the development of induced currents in any closed circuit which is sufficiently near, and in inductive relation to, such changes. In a dynamo, the core of the armature is in such relation to its coils. In an electromagnet, a metal spool surrounding the iron core and itself surrounded by the coils is in such relation. In an induction coil or transformer the core (cylindrical or otherwise), is in such relation to the coils.

Eddy currents, to exist at all, must have a closed circuit within which they may flow; and it is clear that they can readily find such a closed circuit in solid cores, shells, pole-pieces and similar masses of metal; and being developed in the said closed circuits they wastefully absorb power. If now we split, laminate, or divide these masses we break up the circuit within which the parasitical current flows, and thereby prevent, or greatly diminish, their development, and correspondingly reduce the waste. When the eddy current flows in the core or pole-piece of a dynamo machine or transformer, it not only reduces the output of useful current, but also develops heat; and when set up in a brass spool surrounding the pole of an electromagnet or analogous device, it opposes itself to the energizing effect of the legitimate current, and makes a weaker and more sluggish magnet. Therefore these eddy currents must be *discouraged*, except when, as in the regulating sleeve of an induction coil, we can make them useful; and lamination is our means for discouragement.

Now there is no difference in kind, between the fine wire division of the induction coil core, and the plate or true lamination division of the drum armature core. To state the proposition conversely, the difference between the built-up plate ring core of the Schuckert machine, or the laminated core of the modern transformer, and the finely divided wire core of the old-fashioned Page–Callan–Sturgeon–Ritchie–Ruhmkorff induction coil, is but one of degree. Both are finely divided iron, and both are finely divided for the same broad reason, namely, to prevent waste of energy.

Somebody, somewhere, has said that a Frenchman when asked to differentiate the several well defined and separate agonies of rheumatism and gout, did so by saying, "Put your finger in a vise and turn the screw until it hurts so that you cannot bear another turn; that is rheumatism. Then give one turn more, and that is gout." Just so; divide your core or your shell into thin plates, scales, or laminæ, pile these in layers one upon another, and you have a laminated core or shell. Then take the core so composed, set it up so that you see the flat side of the top plate, and cut the pile through again and again until you have sliced your plates into rods, and then you will have a fine wire core, or a core of finely divided iron, such as we have always been accustomed to associate with "shocking coils."

In preventing waste of energy by dividing iron cores or analogous masses, there is in addition to the discouragement of eddy currents, another element of waste to be looked out for. This element does not concern any other metal but iron. The molecular friction now known as hysteresis, opposes such swift magnetic change as is called for in the cores of generators and transformers. If swift magnetic change is forced upon a core, shell, or pole-piece, in spite of this opposition, heat is developed, and in this way also we have waste and loss. But the magnetic friction or opposition to change of a considerable mass of iron is much greater proportionately to the forces producing such change, than is that offered by an equal amount of iron when finely divided, and thus by laminating, we also diminish the heat and consequent loss attributable to hysteresis.

In generators of all kinds there is a third point of advantage in lamination. We must, of course, class under the head of generators not only the magneto or dynamo electric machine proper, but also the converter or secondary generator, the motor, and the choking coil, including all forms of retardation coils or electromagnetic resistances, inasmuch as these last owe their very existence to the fact that they develop counter E. M. F. The E. M. F. a generator develops, is, of course, dependent upon three factors, that is, the intensity of the field, the speed with which that field is traversed, and the amount of active conductor exposed to the action of the field. The second factor must include the speed with which the magnetism of a core or shell can be charged, discharged or reversed. Now small magnets can be charged, discharged, and reversely charged much quicker with a given force than can large ones. It takes a great deal more work to magnetize a solid mass of iron all through, to demagnetize it, and to magnetize it again with reversed poles, than it does to effectually magnetize and demagnetize an equal amount of iron when split up into thin plates and rods. The tendency of lamination here, is to save both time and work, and thus again there is an actual gain in result, in proportion to the expenditure of power. For, since magnetic change is facilitated, and made quicker and more perfect, the result is that the counter E. M. F. generated has a higher value; and the advantage is much more decided when the impressed changes of current, such as reversals, have a high frequency. These three factors then combine to produce the useful result of lamination or division.

The direction of division, as has already been stated, must, to accomplish the prevention or minimizing of eddy currents, be across the line of such currents; otherwise the circuit within which it flows will not be broken; and inasmuch as the parasitic current circulates round the core, as does also the exciting current in the insulated wire coils, it becomes obvious that the direction of division should be at right angles to the coils within which the exciting current circulates.

The component parts of the divided core or shell must also be in some way insulated from each other, as otherwise all that is accomplished by the division is to increase the resistance of the eddy current circuit. In some cases this insulation is brought about by applying an insulating coating to each lamination or wire; but in many cases, for example in the cores of the step-up induction coils, a layer of non-conducting oxide has been found sufficient.

ON THE EXACT ADJUSTMENT OF STANDARDS OF RESISTANCE AND THE DETERMINATIONS OF TEMPERATURE COEFFICIENTS.—II.

BY

Elmer G Willyoung

In the regular routine work of our laboratory we have been using thus far, for this work, a slide-wire bridge of the writer's design having three wires; only one of these wires is used as the bridge-wire proper and only this one is calibrated; one or both of the other two are thrown in multiple, as desired, with the first one, in order to reduce the effective resistance of the bridge. This does not, of course, change the calibration. This construction has fulfilled the second of the above specified essentials in a fairly satisfactory manner; good construction and design, of course, takes care of the first. In the bridge referred to, the wires were of the orthodox length of one meter. The 3d, 4th and 5th desiderata are, however, not so easy to fulfill in the ordinary pattern of bridge.

The result of my own experience in bridge work and of observation and inquiry into the methods of others has led me to conclude that any design of a Wheatstone bridge which is intended for exact work is fundamentally bad if it makes use of a straight wire of any length stretched between two points. I have several reasons for this belief. A bridge used in the average laboratory can not but be subjected to considerable variations of temperature from one time to another; sometimes this will not be over 5 or 10 degrees for an entire month at a time; again it may be 20 degrees in about as many hours. As the bases of most slide-wire bridges have been of wood having a coefficient of expansion considerably different from that of the german silver or platinum-iridium wires mounted upon them, it is evident that their temperature variations must produce, at times, considerable strain upon the soldered junctions of wire and end pieces when the wire has been tightly stretched, and it *must* be tightly stretched if good work is to be done. Probably the greatest strain, however, does not arise so much from the difference of expansion coefficients as from the change produced in the dimensions of the wooden support by reason of its absorbing or giving out moisture; for purposes of instrument construction it is practically impossible to find wood so well seasoned as not to deform in a very short time.

It is, consequently, not surprising that very few straight slide-wires ever remain in position very long. In fact I have never yet seen a straight wire bridge upon a wooden base, with wire stretched tightly enough to make an accurate measurement, whose wire would hold fast without pulling out within a week. The only remedy is to either place the wire upon a compensating base, or else to arrange the wire so that it may be slackened when not in use. In the "three-wire" bridge previously spoken of, the wires were fastened to sliding copper end plates which could be tightened and fastened to the end pieces proper by heavy copper connecting straps. But this having to tighten the wires is a nuisance, requires some strength, and is apt to mean slightly different settings and consequent lengths of wire at different times.

I have recently finished designs for a three-wire straight bridge from which the first instrument is now being made. Instead of a solid base the support for the wires will be a skeleton frame work of brass rods, the coefficient of expansion of which is not very far removed from that of the alloys which are usually used for bridge wires. A straight wire bridge has, however, still another defect, to my mind, fully as serious as the one mentioned. This is the tendency to the development of thermal currents, particularly where the wire is joined to the end coppers; the ends of the wire being a meter apart, it is entirely possible and indeed probable, that differences of temperature will exist in the air at the two ends of the wire, of sufficient amount to develop thermal electromotive forces of very appreciable values.

To make perfectly clear how important a consideration this is I must again refer to the theory of this "Carey-Foster" method. Let us assume that we are comparing two standard ohm coils together and that we wish to know one in terms of the other to an accuracy of $\frac{1}{200}$ per cent. that is, that we must have a deflection of the galvanometer needle when the slider is but $\frac{1}{20000}$ ohm from perfect balance. We will assume that we are using one cell of battery giving about one volt effective E. M. F. at the junction with the bridge arms. Since there are two ohms on each side the fall through $\frac{1}{20000}$ ohm is $\frac{1}{40000}$ of a volt. Let us also assume the bridge wire to be of german silver and the terminal ends to which the wire is fastened, copper. The thermal E. M. F. of this couple, assuming that the one end is at a temperature of 19 degrees and the other at 21 degrees C., a difference of but 2 degrees, is, according to Prof. Tait's table of thermoelectric heights

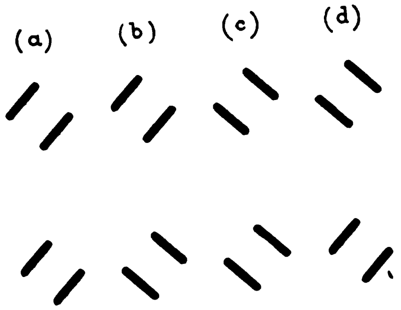

FIG. 5.

$$\begin{array}{lr} \text{German silver,} & -\ 1{,}207 - 5.12\ t \\ \text{Copper,} & +\ \ 136 + \ .95\ t \\ \hline & -\ 1{,}343 - 6.07\ t \end{array}$$

$$\text{E. M. F. per degree, } -1{,}343 - (6.07 \times 20) = 1{,}464 \text{ C. G. S.}$$

$$\text{E. M. F. of couple } 1{,}464 \times 2 = 2{,}928 \text{ C. G. S.} = \frac{3}{100{,}000} \text{ volt.}$$

This value just obtained is a trifle *greater* than the E. M. F. which must be detected by the galvanometer, and will, of course, throw our observations out by exactly the same amount and prevent our obtaining the required accuracy; if this happens when there is only *two* degrees difference between the ends and when but $\frac{1}{200}$ per cent. is aimed at, how will it be when there is four or five degrees difference, as there often is, and an accuracy of $\frac{1}{300}$ or $\frac{1}{400}$ per cent. to be attained and in addition innumerable other thermal E. M. F.'s due to other portions of the apparatus?

Of course there are other ways of eliminating the influence of thermal currents. The simplest is to use the galvanometer in place of the battery and to close the battery circuit upon the bridge wire. This plan is, however, not to be recommended. Another good way is to reverse the battery current, the thermal E. M. F. thus acting at one time *with* and at the other *against* the battery E. M. F.; the mean of the two is then the balance reading. This is easily accomplished in the apparatus which has been described by first taking readings with commutators turned parallel and then with commutators at right angles. For example, there would be four commutator positions necessary, as shown in Fig. 5. The difference of the mean of *a* and *b*, and the mean of *c* and *d* would represent the desired difference between x and s.

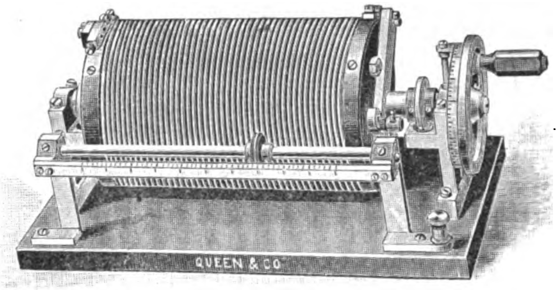

FIG 6.

The orthodox straight wire bridge, also, occupies considerable space and spreads out the apparatus necessary for the more common measurements in an undesirable manner, besides, in the case of regular Wheatstone bridge work, requiring one to get himself into all sorts of impossible positions in order to obtain and read his "balance." On account of all these reasons I personally favor a wire bridge having a wire bent one or more times about a circle or cylinder rather than the straight wire pattern.

A circular wire bridge, if well made, does all that the straight pattern will do and does it much more conveniently; it occupies but little space and brings the readings where they can be easily read; the ends of the wire are close together so that there is practically no difference in temperature between them, and the form is necessarily such that the wire cannot pull out of the end junctions. The contact also is usually a rolling, wheel contact giving a tangent point of contact and hence is not liable to injure the wire, as are most of the cutting "knife-edge" contacts on the usual forms of straight bridge. These conclusions as to the relative efficiency of straight and circularly laid wires in "slide wire" apparatus are not merely theoretical; they are practical, having been founded upon my own personal experience with both types in the making of very accurate measurements and upon the experience of those associated with me who are using the method every day in commercial work.

The form of wire bridge arrangement which I have finally been led to favor in preference to others is shown in Fig. 6 and, diagramatically in Fig. 7. The wire is here coiled upon a hard rubber cylinder 4 inches in diameter and 7 inches long; this cylinder is highly polished and the wire is stretched in a screw thread cut in its surface. There are 50 turns of wire upon the cylinder. In front of the

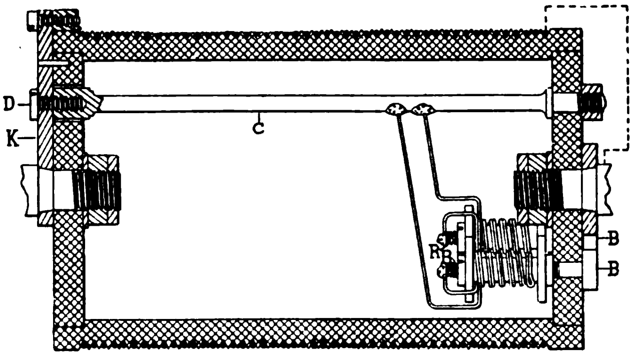

FIG 7.

cylinder is a scale, running the entire length of the cylinder, and, between the cylinder and scale, a small wheel sliding upon a bar carried by the same supports as the scale. This wheel bears snugly against the wire, the end supports being platinized and turned to as true a circle as possible so that the tangent contact is very sharp and definite. As the cylinder is caused to revolve upon its axis, by turning the handle at the end, the little contact wheel travels along the scale always in contact with the wire. The long scale indicates how many complete turns have been made.

In order to obtain the fraction of a turn, the wheel at the end is divided into 100 parts and each of these parts can be easily divided by the eye to tenths; this graduation is read by reference to a zero mark at its side, visible in the engraving. The bridge wire is thus divisible into 50 x 100 x 10 = 50,000 parts. In order, however, to measure accurately the extremely small resistances represented by the increase of resistance of, say, a platinum silver 1 ohm standard for 10 degrees C. increase of temperature, we must have a lower resistance bridge wire than could be obtained by bending any flexible wire upon a cylinder only 4 inches in diameter. The wire has, consequently, been shunted by two shunts placed inside the cylinder itself; these shunts are such that the total resistance of the bridge wire may be either 1 ohm or $\frac{1}{10}$ ohm, as desired, and are arranged so that either may be used by simply inserting a small plug at the end of the cylinder. If we use the $\frac{1}{10}$ ohm shunt the smallest difference measurable with the combined apparatus is $\frac{1}{50,000} \text{ x } \frac{1}{10}$ ohm = 0.000002 ohm; it is thus easy to measure, with great accuracy, an extremely small difference between two coils or to determine temperature coefficients even though extremely small.

The method of arranging the shunts in this apparatus is worthy of notice; they are so placed that their adjustment by the maker is easy and convenient. Referring to Fig. 7, the shunts are each mounted upon rods, B, screwing into the end blocks B; one end of each shunt is soldered to its rod. The other ends of each shunt are soldered to the rod C. In adjusting, the right hand head of the cylinder is slipped into position carrying with it the shunts and rod C; the shunts are adjusted as accurately as possible and the head slipped back. As the head slips into place, the rod C shoulders against a heavy copper strap K, connecting with the left hand end of the bridge wire. A copper screw D then taps into both the strap K and rod C, thus making a clean, fresh screw connection between them; a careful measurement of the total resistance is now made, the amount of necessary correction noted and the head again slipped out. A very few trials will suffice to get the desired resistance with great accuracy.

The heavy copper end straps to which the ends of the bridge wire are soldered, are coned very tightly upon the shafts of the cylinder. These end shafts are of solid copper $\frac{1}{2}$-inch in diameter, and revolve in heavy copper bearings brazed directly to the straps going to the commutating attachment. On the inside of each bearing is formed a massive mercury cup in which revolves a copper ring $1\frac{3}{8}$ inch in diameter and $\frac{1}{8}$ inch thick; these rings are sprung upon each end bearing and fit very tightly. Over half a square inch of their surface is always under the surface of the mercury which is always kept at the same height. The surface of copper contact is so large and the thickness of mercury so small that the resistance at these places is negligible; it is also constant. A sliding brush contact will not answer for work of this kind as the contact resistance is apt to be variable. In order to prevent the mercury from spreading, by capillary attraction, over the adjacent copper surfaces, each copper ring is clamped just outside the shaft between rubber washers, recessed, and filled with sticky wax; this wax pressing against the copper will, it is hoped, aided by the thick bands of lacquer, keep the mercury in its proper place.

Particular attention must be drawn to the fact that every particle of metal forming, in any way, part of the circuit or in contact with it, is of copper in both the commutator and cylindrical bridge, with the exception of the wire itself. This is necessary not only to keep the resistance of the circuit small, but also to avoid thermal currents and contact E. M. F.'s. In the earlier apparatus referred to in Part I. of this paper, it has been impossible to do the highest grade of work without thoroughly wrapping a large part of it in cloths or paper to keep down the thermal currents, and this, despite the fact that about the only metal except copper was in the binding posts. These, however, are sufficient to generate disturbing E. M. F.'s of sufficient magnitude to effectually mask the results desired, and it was seen to be imperatively necessary to get rid of this *entirely*. In the present apparatus the binding posts, connectors, cups, shafts, shunt rods, C and K, the terminal blocks of the shunt coils etc., are all copper; only the junctions of the wire itself can possibly give trouble, and this, experience has shown, need not be feared in the cylindrical bridge.

It is obvious that by simply replacing X and S, Fig. 1, by negligible resistances we convert the arrangement into the simple Wheatstone bridge; hence, in the apparatus in Fig. 3, we need but to place short, heavy copper wires in place of the standards on each side to enable us to use the device for ordinary work.

Often it is desirable to measure *spools* of wire quite accurately, say, to $\frac{1}{20}$ per cent., as, for instance, in the adjustment of a high grade resistance box, where the coils must be as accurate as possible before putting into the set, since any adjustment *then* would involve the loosening and re-making of a soldered joint and entail much inconvenience. With this apparatus this work can be done in one-fifth the time necessary with the usual apparatus and with a more certain accuracy. Since, in such case, it would not be worth while to solder wire ends to heavy coppers for immersion in the mercury cups, and since, indeed, the accuracy wanted does not require it, binding posts have been provided for this purpose just back of the mercury cups. These posts are of the "double grip" style, designed by Queen & Co., and shown in section in Fig. 8, and will catch the finest wires securely, either in the hole A, or between the surfaces K; the resistance of quite heavy copper conductors can thus be measured.

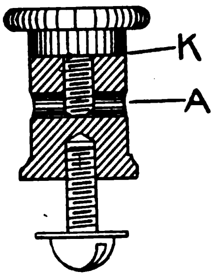

FIG. 8.

Many results obtained with and showing the performance of this apparatus might be given. The following, transcribed from one of our laboratory note books, is sufficient, however, to show the exceedingly high accuracy obtainable. It is the record of a standardization of a coil recently sent to us by one of the large universities for an exact determination of its value. The data, as will be observed, were obtained on four different days when, of course, minor conditions and the personal equation were likely to be very different:

ELIOTT OHM No. 106.

(*a*) Oct. 27, 1892.			
Mms. to balance —	358.3	Value in ohms —	0.01250
Temperature of st'n'd (E. No. 186)	13°.0C	" of standard	0.99675
Temperature of ohm No. 106	13°.25C	" of ohm No. 106	0.98425
(*b*) Oct. 27, 1892.			
Mms. to balance —	355.0	Value in ohms —	0.01239
Temp. of st'n'd (E. No. 186)	12°.7C	" of st'nd	0.99667
Temp. of ohm No. 106	13°.3C	" of ohm No. 106	0.98428
(*c*) Oct. 27, 1892.			
Mms. to balance —	429°3	Value in ohms —	0.01502
Standard (A)	......	" in st'n'd	1.00608
Temp. of ohm No. 106	42°.1C	" in ohm No. 106	0.99106

(*d*) Oct. 27, 1892.					
Mms. to balance	—	424.8	Value in ohms	—	0.01487
Standard (A)	......		" of st'n'd		1.00608
Temp. of ohm No. 106		42°.3C	" of ohm No. 106		0.99121
(*e*) Oct. 28, 1892.					
Mms. to balance	—	171.4	Value in ohm	—	0.02091
(Standard (A)	......		" of st'n'd		1.00608
Temp. of ohm No. 106		18°.0C	" of ohm No. 106		0.98517
(*f*) Oct. 28, 1892.					
Mms. to balance	—	596.3	Value in ohms	—	0.02087
Standard (A)	......		" of st'n'd		1.00608
Temp. of ohm No. 106		18°.1C	" of ohm No. 106		0.98521
(*g*) Nov. 7, 1892.					
Mms. to balance	—	293.9	Value in ohms	—	0.01029
Standard (B)	......		" of st'n'd		0.99588
Temp. of ohm No. 106		18°.1C	" of ohm No. 106		0.98559
(*h*) Nov. 10, 1892.					
Mms. to balance	—	284.3	Value in ohms	—	0.00995
Standard (B)	......		" of st'n'd		0.99587
Temp. of ohm No. 106		19°.5C	" of ohm No. 106		0.98592
(*i*) Nov. 10, 1892.					
Mms. to balance	—	284.8	Value in ohms	—	0.00997
Standard (B)	......		" of st'n'd		0.99585
Temp. of ohm No. 106		19°3C	" of ohm No. 106		0.98588

ACCURACY OF RESULTS.

Date.	Test.	Value.	T—°C	Accuracy of agreement with temp. coeff. applied between.	
Oct. 27, 1892	(*a*)	0.98425	13°.25C	(*a*) and (*b*)	$\frac{1}{500}$%
" "	(*b*)	0.98428	13°.3C		
Oct. 28, 1892	(*e*)	0.98517	18°.0C	(*e*) and (*f*)	$\frac{1}{500}$%
" "	(*f*)	0.98521	18°.1C		
Nov. 7, 1892	(*g*)	0.98559	18°.1C	(*g*) and (*h*)	$\frac{1}{500}$%
" 10, "	(*h*)	0.98592	19°.5C		
" " "	(*i*)	0.98588	19°.3C	(*g*) and (*i*) (*h*) and (*i*)	$\frac{1}{1000}$% $\frac{1}{1000}$%

DETERMINATION OF TEMPERATURE COEFFICIENT.

(1)

From (*c*) we have 0.99106 ohms at 42.°1 C.
" (*e*) " " 0.98517 " " 18.°0 C.
Difference is 0.00589 ohms for 24.°1 C.

$$\therefore \quad \text{Temp. coeff.} = \frac{0.00589}{24.1 \times 0.98517} = 0.000252.$$

(2)

From (*d*) we have 0.99121 ohms at 42.3 C.
" (*f*) " " 0.98521 " " 18.1 C.
Difference is 0.00600 " " 24.2 C.

$$\therefore \quad \text{Temp. coeff.} = \frac{0.00060}{24.2 \times 0.98521} = 0.000252.$$

Summary.—Between Oct. 28 and Nov. 7 the temperature was, at times very low. This caused the increase noted in (g), (h) and (i) over (e) and (f). The fall between (a,) (b), and (e), (f) was due to the heating to which the coil was subjected in (c) (d). This coil, No. 106, was of platinum silver and this *permanent increase* if subjected to low temperatures, and decrease if to high, are well-known characteristics of the alloy. The present value of the coil is given by (*g*), (*h*), (*i*); this value holds providing the limits 12.°0 C and 25.°0 C are not exceeded. After noticing the permanent change in resistance above referred to, I wrote to Prof. H. S. Carhart, who had sent us No. 106, telling him of it and saying that it probably occurred as a result of the heating necessary in getting its temperature coefficient but did not give him the coefficient we had obtained. In his letter of reply he said: "I meant to tell you not to heat the standard as we have very carefully determined its coefficient. It is not over 0.00025, I think." This, as contrasted with our value given above, is a difference of but $\frac{1}{5000}$ per cent. and shows what close work can be done with the apparatus in the hands of different observers in different places at different times.

A MERCURY ARC LIGHT.

Some interesting demonstrations were given at a recent meeting of the Physical Society of Berlin by Dr. Arons, who exhibited an arc light between mercurial electrodes in *vacuo*. The light was of a very brilliant quality, but was rather unsteady at the anode. No variations were observed at the anode when its intensity was very nearly equal to that of an ordinary commercial arc light. In spite of this, however, the temperature was by no means high; it was hotter at the cathode than at the anode. A spectroscopic examination of the light disclosed the existence of a yellow, a green and a blue line, but nearly 20 new lines were observed in addition to those due to the incandescence of the mercury. Some researches on the use of amalgams of mercury are in progress, from which some interesting results may be expected; already fairly good results have been obtained with sodium amalgam. The "telephone method" showed that the current is discontinuous, but no measurements of the resistance of the arc have yet been successful.

PHOSPHORUS MAKING BY ELECTRICITY.

An invention referring chiefly to improvements in the extraction of phosphorus by electrical furnaces has recently been elaborated by Mr. T. Parker. The object is to overcome the objections arising from the condensation of this substance in the upper part of the charge of such furnaces. The improvement consists in making the upper part of the furnace a sort of retort, which is heated to retain the charge in this part at such a temperature as to prevent the condensation of the phosphorus. This process claims to economize the electrical heat in the arc of the furnace.

THE ACTION OF AN ELECTRIC CURRENT IN DISPLACING A MAGNET ON MERCURY.

This subject has recently been brought before the Paris Academy of Science by Mons. C. Décharme in a short paper, in which he states the results of some observations recently made by him. The more important of these, says the London *Electrical Review*, may be summed up as follows:—Using perfectly pure mercury (an essential condition) for supporting a magnetic needle and leading the current into the mercury by dipping conductors carrying it into the mercury at different points, it was found that before assuming the position of equilibrium and thus conforming to the well known law of Ampère, the needle travels here and there over the surface of the mercury in a curious way, which appears to be governed by the ease with which it can travel in a direction parallel to its longer axis, and the difficulty of moving in a direction perpendicular to this axis. One of the most interesting effects was produced by making the current cross the surface in a direction perpendicular to the longer axis of the needle, with the negative pole of the current on the left of the south-seeking pole of the needle. Under these circumstances it was observed that the needle first moved away in a direction parallel to its longer axis, then turned round and finally returned, taking up the normal position according to Ampère's law. The paper in which these and other results are arranged may be consulted in the *Comptes Rendus*, Vol. cxv., No. 18, pp. 651—52.

NEW YORK YOUNG MEN'S INSTITUTE

In the educational department of the Young Men's Institute, of the Young Men's Christian Association of the City of New York, 222 and 224 Bowery, much attention is being given to technical studies, and the work is becoming more and more valuable to mechanics and artisans. The evening classes in electricity, steam engineering, carriage drafting, mechanical drawing, shorthand and typewriting, vocal music, free hand drawing, arithmetic, bookkeeping and English grammar have an enrollment of almost three hundred young men. The Institute committee of management and the Carriage Builders' National Association award prizes, diplomas and certificates of progress.

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Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
Western Editor and Manager, L. W. COLLINS. 347 The Rookery, Chicago, Ill.
New York Representative, 208 Broadway, } W. F. HANKS.
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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XV. NEW YORK, JANUARY 4, 1893. No. 244.

ELECTRIC POWER TRANSMISSION SCHEMES ABROAD.

THE heroic manner in which the utilization of Niagara Falls for industrial power purposes has been attacked in the United States has evidently stimulated foreign capitalists to consider more seriously the utilization of available powers abroad. Among the most recent of these schemes is the enterprise for utilizing the water power of the river Rhone in France, by converting it into electricity for distribution in the city of Lyons and its suburbs. It is proposed to construct a canal tapping the waters of the Rhone about 17 miles above Lyons, and to bring this diverted stream down to a point just outside of the city. Here there will be established 20 turbines of 1,000 h. p. each, which will be coupled to dynamos. By this means, it is hoped to infuse new life into the industry of silk weaving in the homes of the workers, by furnishing them with cheap power in small units, and thus to counteract the influence of large factories to which weavers have found themselves driven by the sharp competition of wholesale producers making an inferior product. In this case as in that of Niagara, at least as far as contemplated at present, the manufacturers will be within comparatively a short distance of the generating dynamos.

But another scheme, proposed in England by Mr. B. H. Thwaite, in a paper read before the Manchester Association of Engineers, is now being brought forward, and it appears to be so well advanced that specifications from a number of well known firms have been asked for. In its essentials this scheme is not new, being that suggested some time ago, namely, the burning of the coal at the pit mouth, the conversion of the thermic into electrical energy on the spot, and the transmission of the current over long distances. The details of Mr. Thwaite's proposal however, are decidedly interesting. In the first place it is proposed not to burn the coal under boilers and to employ steam engines, but to convert the solid fuel into a gas; second, to abstract the nitrogenous value from the fuel and convert it into agricultural fertilizers; third, the direct combustion of the fuel gas in the cylinder of the gas engine; and finally the driving of dynamos by means of the gas engine.

While we are not placed in possession of the detail figures, Mr. Thwaite claims that by his method of operation, 1 h. p. hour could be obtained with the expenditure of from ⅝ to 1 pound of solid fuel, owing to the high efficiency of the gas engine; moreover, the fertilizing value from this fuel would be equivalent to the nitrogen contained in from 22 to 28 pounds of ammonia sulphate. Indeed it is claimed that for power delivered in London from the Midlands, the coal consumed would only figure as two per cent. of the entire cost of power as delivered.

Mr. James Swinburne has prominently identified himself with this scheme, which appears to be thoroughly feasible, and well worked out. The conditions prevailing in England—the most compactly settled manufacturing country in the world—make it particularly adapted for such a system of power distribution from town to town. The route laid out for the electric lines embraces many small but busy manufacturing towns where power could be distributed at a profit.

While, as above stated, the distribution of power from Niagara, as laid out for the present, does not contemplate transmission beyond a radius of about 25 miles, it does not by any means follow that this will be the ultimate limit. On the contrary, with the knowledge and experience already gained with high tension currents, distribution at far greater distances may be looked for at an early date. In the same way the distribution of electricity from the coal pit is quite applicable to conditions as they exist to-day in this country, and, we may add, has even been contemplated in certain quarters. The English scheme, if put through, cannot fail to have a marked influence on the entire industry, and it is to be hoped it will find its realization in the near future.

STORAGE BATTERIES IN CENTRAL STATIONS.

WE give space in this issue to another communication from "Gautherot" on a subject which we are convinced will, sooner or later, occupy the serious attention of central station managers in this country. The reasons which have militated against the use of storage batteries in this country have already been discussed by us quite frequently of late and are alluded to by "Gautherot," who also gives some additional facts, the force of which will be recognized by all thoughtful students of the storage battery situation in this country. Our contributor holds, in effect, that the storage battery companies themselves are largely to blame for the condition of affairs existing to-day in the United States, and that being the case, he boldly asserts that a company willing and able to furnish the desired article on strictly business principles need fear but little from those claiming a right to the monopoly of this valuable adjunct to electrical distribution.

THE STROWGER AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

BY

H. W. Underwood

SINCE the telephone has come into general use, there have been a number of improvements made, not only in the transmitter and receiver but in the form and style of switchboards used for making the several connections. Enough has been said by others regarding the old style and form of multiple switch boards, without making it the subject of this article.

What I desire to describe here is a new and improved apparatus, known as, "The Strowger Automatic Telephone Exchange Switchboard," whereby all connections are automatically made through the closing of the electrical circuit by means of a key placed upon the table of the battery box on each telephone. Placed at a central point are as many of the automatic switches as there are telephones in the exchange, each switch being connected with a telephone.

Let us first dwell upon the electro-mechanical part of the system, namely, the automatic switch. This is a small machine, measuring 6 x 3½ x 4½ inches over all, giving 500 connections, and containing four electromagnets, each having the same electrical resistance. To the armature of each magnet is attached a lever and near the end of this lever, a pawl, which, when the armature is attracted, falls into place in a ratchet wheel which is attached directly to the shaft of the switch, at the extreme end of which is a contact arm which connects the several lines together when moved into position by manipulating the keys at the telephone. At the extreme end of the lever is a dog which prevents the shaft from turning more than the desired distance, that is, not more than one point when the "units" key closes the circuit, or more than 10 points, when the "tens" key closes the circuit. The operating of the several keys, will be explained in detail later on.

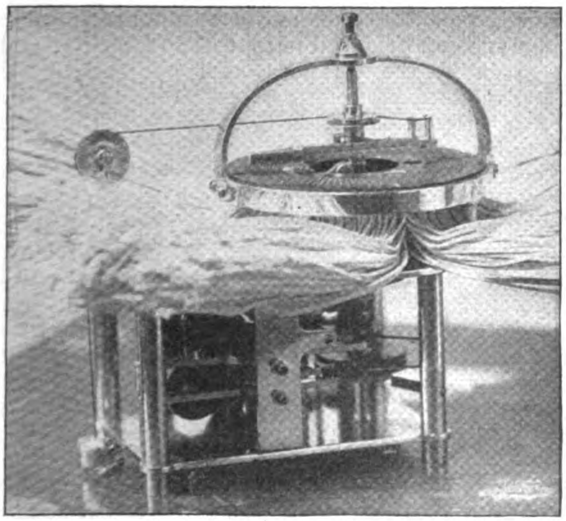


FIG. 1.

Upon a small rubber disc in circular rows of 100 and extending about $\frac{1}{64}$ of an inch above the surface of same, are located the several phonic wires of the several telephones connected with the exchange. Fastened to the end of the shaft to which the cog wheels are fastened, is a contact arm, by means of which the several phonic lines are connected with the telephone from which the call is sent out.

The movement of this arm is circular, being pivoted at the shaft; and as the arm moves around from its normal to any of the phonic lines, it takes a step by step movement, thereby doing away entirely with all friction, which, if it were not for this step by step movement, would be a serious drawback in many ways. In all other systems of automatic exchanges, friction has been so great that when put into practical operation they would not work, and were so cumbersome that a very few could be put into a good-sized room. But when we take into consideration the extremely small amount of space occupied by the Strowger automatic telephone exchange switch, and that there is no friction, and that the space is actually reduced to a minimum, one can readily see how simple and practical an automatic exchange must be.

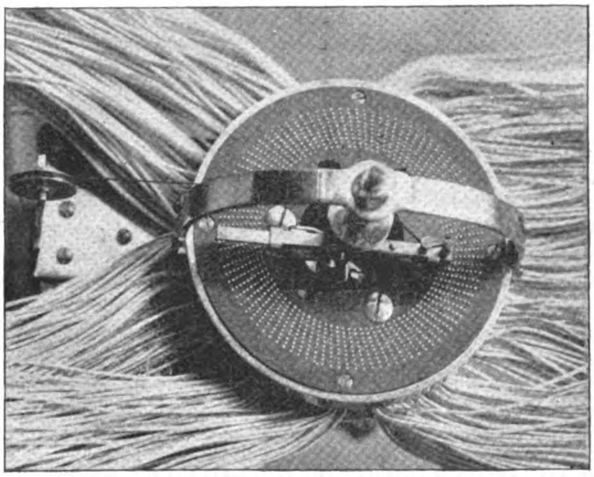


FIG. 2.

The keys or buttons which are placed on the battery box of each telephone, and mounted upon a thin rubber plate, are five in number, marked as follows: "1000," "100," "10," "1," "R." With this size of key board, 10,000 connections can be made, which will cover more than the largest exchange in the world to-day. The calling is done on a decimal system and the largest decimal in any desired number is called first. For example, in calling No. 1231, one closes the "1000" button once, the "100" twice, the "10" three times and the "1," or unit, once. There has been then automatically established direct communication with telephone No. 1231; then at the conclusion of the conversation, by the closing of the release button marked "R," the contact arm on the switch is automatically returned to its normal position.

The accompanying engraving, Fig. 1, shows the machine complete for 1,000 connections. The wires which project from under the disc are the several phonic wires or bank wires, as they are termed, when an exchange is set up, running to the several phones. Fig. 2 shows the surface of the rubber disc and the ends of the several phonic lines projecting about $\frac{1}{64}$ of an inch above the surface. The contact arm can be seen close to the shaft and attached to same, being there shown at its normal point, ready to be called by any of the other telephones, or to be connected with any of the phonic lines on the surface of its disc. The small weight which can be seen in Fig. 1 is used to bring this arm back into its normal position. The movement from one circular row to the other is operated in the same way as from one phonic line to another in the several rows, each row, as I have mentioned before, containing 100 wires. The space occupied by this 1,000 connection machine is about ¼ of an inch larger in the disc only, than that occupied by the machine for 500 connections.

I might mention in closing that La Porte, Ind., has today the first perfectly working automatic exchange system in the world, the opening of which was noticed in THE ELECTRICAL ENGINEER of Nov. 16. This system fully demonstrates in a thoroughly practical manner the many advantages obtained in the use of an automatic telephone exchange system.

THE EFFICIENCY OF ALTERNATING PLANTS.

BY

Harris J. Ryan,

THE letter published in THE ELECTRICAL ENGINEER, of Dec. 14, 1892, relating to the performance of a small alternate current station gives some facts that are rather startling. The clearness with which the correspondent puts his case leaves no doubt in one's mind that there is something radically wrong somewhere.

His case amounts to this: He has 1,300 lights wired from 97 transformers, operated from an 1,100 volt circuit with a ratio of transformation of 20 to 1, and supplied with current from a single machine. His station instruments and lamp current meters are correct, having recently been passed upon by a competent expert. With these he finds for one month of 31 days a primary out-put equivalent to 120,490 secondary ampere hours, while his meter readings sum up for the same time but 72,560. The difference valued in the selling price of a secondary ampere hour amounts to $479.30. His station out-put represents a retailing value of $1,204.90 per month, while he realizes but $725.60.

What the writer has to say is based on the assumption that the station instruments and house meters here used gave correct indications. Then, if we remove the transformer "leakage current" we must under all circumstances find a practical agreement between the ampere hours of the primary multiplied by the ratio of transformation as one quantity, and the ampere hours of the secondary as the other. That this may be realized by means of the station instruments and house meters supplied by makers of standard machinery is established through the results of a long and carefully conducted set of tests made by Messrs. Darlington and Cowan on the alternate currents circuits of a New York City electric lighting plant during April, 1892. After the transformer "leakage current" was removed from the primary ampere hours, this value, multiplied by the ratio of transformation, gave a result that agreed with the secondary ampere hours as read from the house meters to within one per cent. In the case before us then, the difference between the indications of the station ammeter and the house meters is to be accounted for as the "leakage current" of the 97 transformers.

If we assume that the full load capacity of these transformers is 1,300 lamps, or the total number wired on the circuit, which is usually about right for similar plants, the average maximum load for each transformer is 13.4 lamps. Tests reported in the Proceedings of the American Institute of Electrical Engineers, Vol. VII, p. 1, show that for the primary of a ten-light transformer, the ratio of the effective lamp current plus the effective "leakage current" to their value as measured by the ammeter, was 1.1. We shall make no serious error, then, if we assume that the same relation holds here. The sum of the primary lamp and "leakage current" ampere hours is 6,022 × 1.1, or 6,624. The secondary ampere hours for the same time were 72,560, and are equivalent to a primary lamp current of 3,628. The difference between them is 2,996, the ampere hours of primary "leakage current" for the 97 transformers. The actual current is 12 amperes, or .124 of an ampere as the average "leakage current" per transformer. This is a value that is more than twice as much as would be the case with standard makes of to-day. The "leakage current" for the above 10-light transformer of standard make for 1888 had a mean value for all loads of .127 ampere, and the average "leakage current" just deduced for each of the 97 transformers is in remarkable agreement with this figure. From the correspondent's account it is inferred that the plant has been in operation for several years, so that it seems reasonable to conclude that the average "leakage current" of .124 is about correct. The equivalent of this current as a lamp current would roughly be .8 of this value, or .0992, say, .1 of an ampere per transformer, a total of 9.7 amperes, and having an equivalent of 48,000 secondary ampere hours per month.

Numerous tests have been made and reports of them published on transformers produced during the present year by makers of standard apparatus. From these for the large sizes and from Sibley College theses of 1892 for the small sizes the following figures are obtained as the best results recorded:

PRIMARY PRESSURE, 1,000 VOLTS AT 133 P. P. S.

Out-put of transformer:		
In lamps.	In watts.	"Leakage current."
5	250	.040
10	500	.050
20	1,000	.055
40	2,000	.080
130	6,500	.100
350	17,500	.200

From these figures it is evident that by replacing the old transformers with new ones of the best make of to-day, using the larger sizes as far as practicable by connecting houses together, this loss may be reduced two-thirds. 32,000 more secondary ampere hours per month could then be sold to customers without increasing the current output of the station and without burning more coal. This would provide an additional revenue of $320.00 per month against which would be charged the cost of the additional lamp renewals, cost of inspection and the interest on the capital required for making the change and installing the lamps and transformers for the additional service. With this alteration accomplished, the secondary load would be 750 amperes with the dynamo at the full output of 80 amperes, and the figures given by the makers would be realized. This, doubtless, would have been realized from the beginning had a fair proportion of the larger sizes of transformers been installed.

The economy gained in adopting the largest sizes of transformers practicable in small plants that supply current to scattered customers should demand the same attention from the managers of these plants that it does from those who have the care of the large alternate current stations of the great cities. Cornell University is operating a plant of about the size under consideration. There are 1,300 lights wired, operated from 15 transformers with a maximum primary current of 35 amperes at 1,100 volts. The difference between the primary and secondary ampere hours is scarcely perceptible. We use two secondary pressures, 52 volts and 104 volts, with entire satisfaction. Where the secondary wiring is extensive, containing long runs, etc., a pressure of 104 volts is used. We do not clearly see why this plan for scattered customers has not been adopted more generally. Considering the ease with which two transformers may be used for a three wire sub-station, it is somewhat astonishing that this plan, likewise, has not been used more for distributing from the larger sizes of transformers.

AFTER considering the subject for some time the City of Dresden, Germany, has decided to erect an alternating central station, but the contracts for the work have not yet been signed.

ELECTRIC RAILWAY DEPARTMENT.

MAXIMUM SPEED ON ELECTRIC RAILWAYS.

BY

Chas. Steinmetz.

IN THE ELECTRICAL ENGINEER of Dec. 14, I notice an abstract from a German paper, in which the author, on theoretical grounds, limits the maximum possible speed of electric railways to 125 miles per hour, a figure which is so little beyond that reached by the steam locomotive, 97 miles, as rightly to raise a doubt as to its exactness.

Let me say that, especially at these high speeds, an electric motor can be made to yield any required power, so that the speed of the electric railway is undoubtedly *not* limited by the capacity of the motor. The limit of speed, however, is set by the ratio of train-resistance to adhesion.

A propelling force, revolving the car axles, will evidently cause motion, that is, acceleration only, when the *train-resistance* is *less* than the *adhesion*, while, as soon as the train-resistance is *greater* than the adhesion between wheel and rail (as specially noticeable on heavy up-grades), no acceleration, but slipping of the wheels will result. Since the train-resistance increases with increasing speed, while the adhesion may be said to be constant, at a certain speed a point must be reached, where the train-resistance equals the adhesion, and further increase of the propelling force results in no increase of the speed, but in slipping of the wheels. This critical speed, which can not be exceeded, even when all the axles are driving equally, is determined by the coefficient of adhesion and the train-resistance.

With regard to the coefficient of adhesion, the data at my disposition are necessarily limited. But I know, that with both car axles rigidly connected, a grade of 10½ per cent. can be climbed in all conditions of weather, so that the coefficient of adhesion is greater than .105, as witness the electric railway at Lynchburg, Va. With only one car axle driving, on the same grade under unfavorable atmospheric conditions, sand has to be used, though usually the car will start and mount the grade without sand. Assuming even two-thirds of the car weight resting on the driving axle, this represents a coefficient of adhesion of .16. Consequently, we can fairly count upon a *coefficient of adhesion* of about one-seventh or about 300 pounds per ton of weight.

With regard to the train-resistance, tests made on the Hudson River Railroad for speeds up to 70 miles per hour point to the formula:

Train-resistance, in pounds per ton $= 4 + .006\,N^2$, where N is the speed, in miles per hour. (Webb.)

Consequently if it is permitted to extrapolate by this formula, assuming all the axles of the train driving equally, we get: $300 = 4 + .006\,N^2$; or, $N = 220$.

That is, on our present steam railroads, with their heavy rails and well ballasted tracks, the electric motor can reach speeds up to 220 *miles per hour*, requiring at this speed 180 h. p. per ton of moving weight.

But, comparing these train-resistances with the much higher resistances met with in electric street railroading, we are entitled to say, that by the use of still heavier rails and better tracks than are to be found on our steam roads, the train-resistances may still be lowered, and a still higher speed made *possible*, though whether such a road will pay, is another question.

THE COMMERCIAL SUCCESS OF NON-ARCING METAL LIGHTNING ARRESTERS.

BY

Alexander Jay Wurts.

WHILE attending the recent Street Railway Convention at Cleveland, I had occasion to enter into conversation with a gentleman intimately connected with one of the largest electric concerns of this country, and among other things, I asked what his people thought of non-arcing metal lightning arresters. The reply which I received was to the effect, that they had tested the various metals and had failed to discover any marked difference as to their arcing qualities, in fact, that, as far as non-arcing metal was concerned, there "wasn't anything in it."

In regard to the existence of non-arcing metal, although the fact that its discovery was announced before the American Institute of Electrical Engineers would in the minds of many amount to conviction, possibly others, properly slow and conservative to accept such a radical departure from the well beaten path, will be interested in the abundant data now at hand, not only regarding the actual existence of this metal as announced before the Institute, but also as regards its successful use as a commercial article.

In THE ELECTRICAL ENGINEER of April 27, 1892, there was published an article on this subject in which will be found some excellent illustrations taken from photographs, and clearly showing the remarkable, and heretofore undreamed of, results obtained with varying lengths of air gaps; that is, with 1000 volts from an alternating current generator, it is not possible to maintain an arc over two air spaces of 1-32 of an inch each, and between non-arcing metal electrodes. When these air gaps are increased to ½ inch or 1 inch the arcs, when once established, will be maintained with all the fury familiar to users of high potential circuits. In the transactions of the American Institute of Electrical Engineers for March 15, 1892, there are some good illustrations, also taken from photographs, showing the different results obtained when using copper electrodes, and non-arcing metal electrodes.

A simple and interesting test illustrating the instantaneous interruption of the short circuit when using non-arcing metal, is made as follows: Across the terminals of a 1000 volt alternator connect two air gaps of 1-32 inch each, in series, the electrodes being made of non-arcing metal cylinders about 1 inch in diameter and having their axes parallel to each other. In series with these air gaps connect a 20-ampere fuse and a switch. Now bridge each of the two air gaps with a small crumb of tin foil, and throw the switch; the short circuit thus established will be so instantaneously interrupted that the fuse will not be melted, nor will there be a perceptible flicker in the lamps running from that generator.

The following test also illustrates, in a striking manner, the virtue of non-arcing metal. Connect five or six 1-32 inch air gaps as before, in series, and across the terminals of a 1000 volt alternator; then upon closing the switch the short circuit will be so instantaneously interrupted, that with six air gaps, three and often four of the tin foil crumbs will remain unfused. Had other than non-arcing metal been used under similar circumstances it is needless to say that the apparatus would have been instantly reduced to a shapeless mass.

Still another experiment, possibly more remarkable than the foregoing, was described before the American Institute of Electrical Engineers in the following words:

> Pairs of non-arcing metal dischargers were mounted upon thermostatic supports in such a manner that the dischargers of each pair normally rest in contact with each other, and so that any current traversing the system would be forced to pass through the thermostats and dischargers in series. The thermostats were so arranged as to cause the two dischargers in each pair to open away from each other upon the passage of the current. If then a single and permanent air gap were connected in series with this system, that is, an air gap just sufficient to prevent the normal pressure of the line from striking an arc, and, if an arc were started across it, the sudden rush of current through the thermostats would instantly introduce a number of air gaps in the circuit corresponding to the number of pairs of thermostatic dischargers, and thus automatically open the short circuit. This device was tested and found to work admirably. Of course, after the circuit had been interrupted, the thermos'atic dischargers at once returned to their normal positions. In fact, this action is so rapid that if a series of these dischargers be connected in short circuit without a permanent air gap, the circuit will be automatically opened and closed every two or three seconds. In order to appreciate the very remarkable action of this thermostatic device, it must be well borne in mind that with non-arcing metal a very small air gap is all that is necessary for the instantaneous interruption of a short circuit.

I have connected a device of this kind consisting of two pairs of dischargers across the terminals of a 1000 volt alternator and left it there for about 20 minutes, during which time a short circuit was automatically made and broken about every four seconds, without in any way damaging the non-arcing metal. The mere fact that these cylinders do not fuse together is hard to believe, and to this day it remains without a satisfactory explanation. That the short circuit should thus be repeatedly interrupted without vicious arcing, and without the instant destruction of the apparatus is conclusive evidence that "non-arcing metal" has properties very different from the metals ordinarily used for electric purposes.

EFFECT OF TROLLEY ROADS ON NEW YORK FERRIES.

A VERY decided boom is reported in the New York and Brooklyn ferry business. Officials of the Union Ferry Company say that at no time since the opening of the East River Bridge, in 1884, has the business at the ferries been as great as it is now. The reason is said to be the introduction of the trolley as a motive power for surface roads. So many people object to climbing the steps to the elevated stations, it is said, that they take the new trolley cars instead and go by the ferries.

Three of these trolley roads go to Hamilton Ferry, and as a result extra boats have been put on that route, and efforts are being made to get two ferry slips in this city instead of the one now in use at the foot of Whitehall street.

Very large and handsome boats have been put into commission on this ferry and they are crowded with passengers all day and very greatly overcrowded in the morning and evening hours.

When all the trolley roads get down to Fulton Ferry, where two of them now go, the ferry company expects to have double the boat service, and preparations are being made to put on new boats.

ELECTRIC RAILWAYS FOR MEXICO.

JAMES S. CLARKSON, ex-assistant Postmaster-General ; C. T. Meek, president of the Colorado Iron Company ; R. W. Clay, of Philadelphia, and T. H. Blackwell and G. H. Hobart, of New York, have been in the City of Mexico for several days recently, it is stated, negotiating for the purchase of the city and district railways, about 212 kilometres long. The documents have been signed settling the matter. The price is said to be $9,000,000. It is intended to work the railroad by electricity.

ELECTRIC TRACTION IN PITTSBURGH.

THE annual report of the Citizens' Traction Company of Pittsburgh, Pa., shows receipts of $683,471; expenditures, $455,880, and net $227,591. After expending $30,205 for improvements and paying 6 per cent. on $3,000,000 capital stock, there was a surplus of $17,334. The road is an electric line.

TROLLEY EXTENSION IN NEW YORK CITY.

BY a vote of 21 to 4, the aldermen of New York city have granted the following extensions of the trolley system, below the Harlem River, to the Union Railway Company : From the present tracks at One Hundred and Twenty-ninth street and Third avenue east to Second avenue, down Second avenue to One Hundred and Twenty-fifth street, west on One Hundred and Twenty-fifth street to Fourth avenue, up Fourth avenue to One Hundred and Thirtieth street, through One Hundred and Thirtieth street to Madison avenue, up Madison avenue and over Madison avenue bridge to One Hundred and Thirty-eighth street and Third avenue on the north side. Also a spur on One Hundred and Thirty-fifth street from Madison avenue to Eighth avenue (elevated station at One Hundred and Thirty-fifth street and Eight avenue.

MILAN ELECTRIC RAILWAY.

THE municipal council of Milan has granted a concession to the Edison Company in that city for the establishment of an electric tramway (any system), to commence at the Piazza del Duomo, and to terminate at the Porta Sempione. The experiment will be made for a year.

MISCELLANEOUS.

STORAGE BATTERIES IN CENTRAL STATIONS.

BY GAUTHEROT.

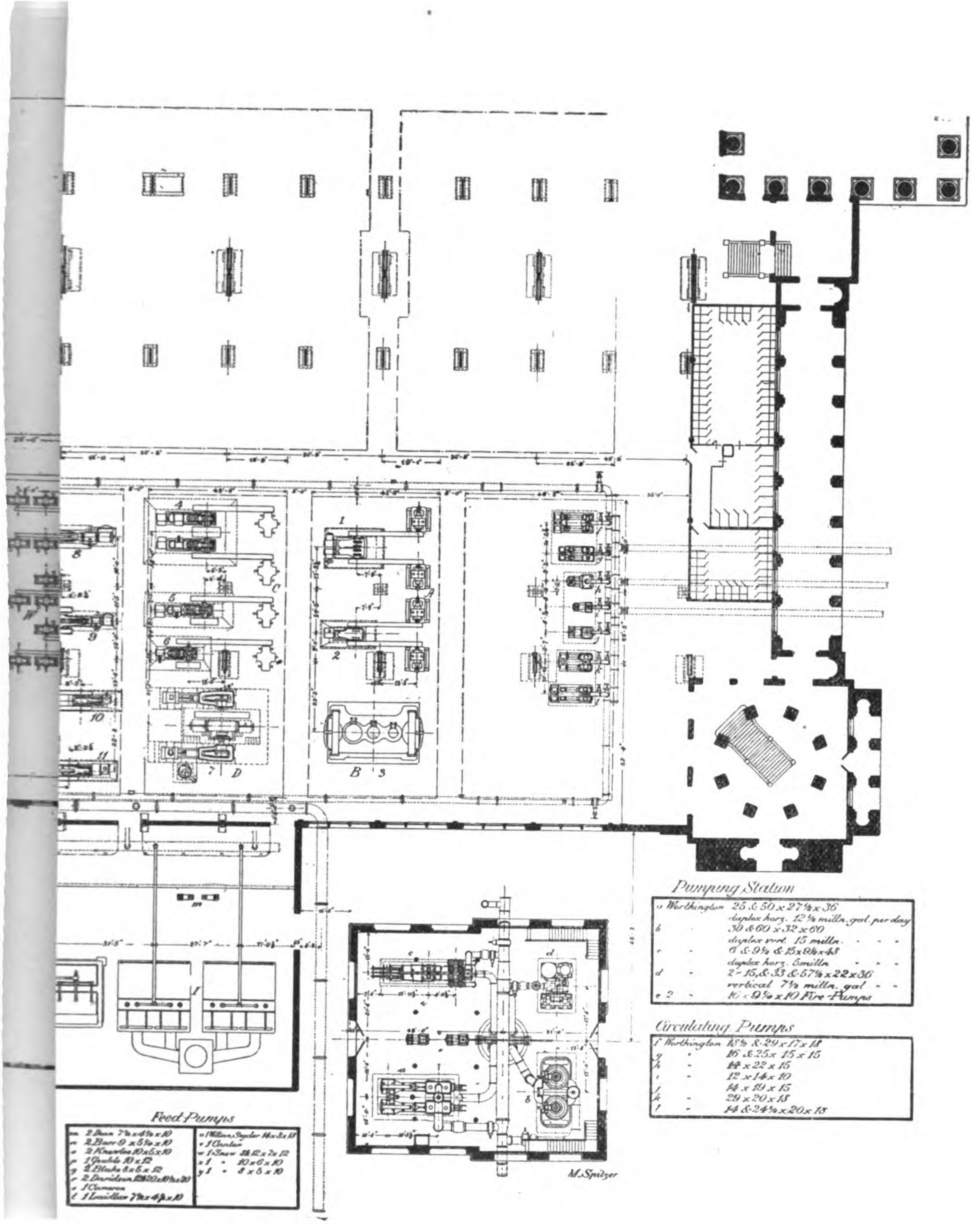
I HAVE followed with considerable interest the several communications which have appeared in your journal within the last few months on the subject of "Storage Batteries in Central Stations," and I must confess I was somewhat surprised at your remarks in the issue of August 31, regarding the impressions of an "American Electrical Engineer" upon the European accumulator plants.

As within the last few years my time has been about equally divided between the two continents and as I have had occasion to visit some of the largest accumulator installations in Europe, the impression left on my mind as to the "smallness of the plants" and the "extreme lightness of loads," is not in accordance with the views of the above mentioned "American Electrical Engineer." I think that some of the more recent publications on the subject of storage batteries in central stations, where there have been given some very interesting particulars regarding accumulator plants in England, France, Germany and Austria are in themselves sufficient proof that there do exist such plants which can scarcely be called "small" nor the loads they carry light. I must give "American Electrical Engineer" credit for having "unearthed" publications and particulars on the part of those who hitherto have apparently preferred to keep wonderfully silent. The fact of their now coming forward to face the public with facts, puts a very "healthy" aspect upon this most important industry.

There has been more or less a cloud of suspicious silence and mystery hanging over the accumulator business. It was not from the fact that the knowledge did not exist, and that the information *could* not have been given, but from the fact that those who could, would not, and those who would, could not. But is not this the case with every young industry, more especially where success depends almost entirely upon practical knowledge and experience and perfecting of details? Those responsible for each advance and who, by careful study and close attention, have acquired the necessary knowledge and experience are naturally not inclined to spread such knowledge broadcast. Then again, where success has been attained, as shown by some of the large installations in Europe, it has been mainly (I may say solely) due to careful study, care and management. For, after all, when all is said and done (notwithstanding the numerous and varied claims upon the subject of patents, construction, etc.), in many instances the materials used, and methods of manufacture of accumulator plates are not so widely different as to account for the successes and failures in working of different storage battery plants.

As a further proof of this, take the case of two companies in different countries, or even in the same country separated by only a few hundred miles, each manufacturing accumulators upon the same principle and under the same patents and each supposed to be working upon the same basis. What do we find? The one is a marked success and the other an utter failure. And what is the reason? Simply management or finance. Very often the former, but more frequently the latter, and very frequently both. In America, especially, storage battery companies have been organized and run upon the principle of too much paper and too little cash. Ninety-nine men out of a hundred who have "got in at 10 cents on the dollar" and are anxiously waiting for the moment to "get out at 20 cents" know no more about accumulators, their requirements and capabilities, than they do about ballooning. They have heard wonderful as to their possibilities prospects and capabilities un-

seen. If confident assertions by various manufacturers and ex-



statements as to their possibilities, prospects and capabilities untold; they have built upon the earlier statements, when repeating them to others, who again place further additions to the structure, until, after passing through a few mouths, the claims one hears made for some particular battery are enough to turn the hair of the unfortunate one remaining man of the hundred, who not only knows the facts but is probably responsible for the management, and what is worse, is expected to make the unfortunate accumulators fulfill each and every statement, expanded or otherwise.

Then again the ignorance of the public generally upon the subject enables competitors to make the wildest statements as regards the superiority of their particular wares in order to accomplish a sale. One frequently finds a would-be purchaser of some particular type of storage battery come to the would-be vendor with the statement that, a Mr. So and So has offered an equally good article, which will do equally good work at 25, 50 or even 75 per cent. less price; and what is he to do about it? If the would-be vendor offers to come down on his price, or if he advises the would-be purchaser to "take the other" the consequences are the same. The purchaser buys the cheapest. And what is the result? It is the case of a boy trying to do a man's work. The battery does very well for a short time, so much so, in fact, that, after finding it will run say 100 lights, the purchaser makes the wonderful discovery, or has been given the wonderful statement, that it will carry 120, yea more, 150, or even up to 200 lights for a short time. He tries it, not once, but frequently, until he finally acquires a habit of running more than 100 lights, whereas in reality 100 lights was nearly double what it ought to carry. He is delighted, and tells his friends. The purchaser of stock at 10 cents asks 15. Meantime the battery is receiving that abuse in working which finally results in a general break down. This results in an all-around abuse of storage batteries in general on the part of the purchaser and of the vendor of this special one in particular.

Not only in electric lighting but also in electric traction the fact that a storage battery is capable of being discharged at a far higher rate than is good for it, has proved one of the chief causes of its failures. No wonder one so often hears the remarks: "Storage batteries! Don't touch them!" "No good, and never will be." "I have tried them,—never again." "No! go, and buy engines and dynamos, but keep off storage batteries," etc. And yet this is all wrong, radically wrong. In some cases engines and dynamos may be more adapted to the work than the use of accumulators, but, as one of your correspondents lately remarked, neither the days and nights, nor yet the habits of the people are so vastly different in the United States and Europe as to make it a universal fact that accumulators are *not* adapted to central station work in America, whereas they *are* so adapted as well as adopted in Europe.

But all their outrageous claims, mismanagement, stock jobbing, competition in prices, etc., have been gone through in England, France, Germany, Austria, etc. It is the old story repeated. What has taken place there will most assuredly take place here. When sufficient people have been bitten and taken in, by believing wild statements; when the subject is a little more understood by the public in general; when companies are started upon sound business principles with competent management and plenty of working capital and when such companies will give substantial guarantees *which they can carry out and be responsible for*, and when purchasers of storage batteries are fully convinced that the cheapest is not the best; that for given work to be performed there is required a given weight of battery in order to ensure the cost of maintenance being within given limits,—when all this has taken place, as it inevitably will, we shall see the accumulator stations in America, on just as large, and in all probability much larger, a scale than any existing, or even dreamt of, in Europe.

I can hear some one whispering, "How about the patent question? Has this not had a great deal to do with checking progress, hampering finances, swallowing up funds and making things generally unpleasant?" I could perhaps say a good deal more than I care to on this subject but I will simply ask, Is the position in America so widely different in this respect from that of any European country? I can from my own personal knowledge say, that if decided statements as regards unassailable positions, broad claims, threats for payments, threats for compensation and royalties, etc., in fact, a general and universal system of attempting to induce the public to believe that each and every man who owns a battery is the one and only man who can or ever will be able to supply batteries,—if, I say, this has anything to do with and carries any weight, I can only add that I have heard as much of this in Europe as in America. Still they exist, all and every one of them. It is true some have been swallowed up or merged into others but still the fact remains that there is more than one accumulator company doing business in each of the various European countries, and in many instances in the same city. Each has been stating that its competitors will soon stop, but somehow they do not stop. It is also true that there have been some very important decisions in the United States Courts lately as regards storage battery patents, but whether this is going to result in the wholesale monopoly that some people imagine, remains to be seen. If confident assertions by various manufacturers and experts are proofs, there is likely to be a very lively competition in the accumulator business in the near future.

Having studied the question very carefully I am forced to admit I see little fear of the public being afflicted with an almighty monopoly in storage battery manufacture. We may see a little more litigation, a little snapping and barking, but I confidently anticipate seeing before long a thoroughly healthy competition in this business. As a matter of fact, there is room for all, and has been for a long time, and I doubt whether the "pull devil, pull baker" system would have gone as far as it has, were it not for the opportunity the various decisions in the Courts gave to various holders of stock of making some pretty quick turns.

How much better it would have been if a few honest dividends had been earned first and the matter of litigation postponed until the real and true value of any special type of battery had been first proved by actual practical work. If after satisfactory proof any special company considered their position sufficiently sound and ultimate prospects worth the expense, then would be the time to endeavor to stop infringers. I think it will be found that in Europe the companies doing the best business have never taken the stand of the aggressors in court. If assailed, they have answered. If assailed again, again they answered. And yet they survive. This fact alone appears to me to prove not only the folly of carrying litigation too far but also that accumulators are a success and capable of surviving many a hard knock.

It must be confessed that Americans with their usual spirit of go and enterprise tackled the most difficult part of the problem first. It was a case of trying to run before they could walk, in facing the problem of storage battery traction before having acquired more experience in the application to lighting on an extensive scale. At the same time there is more sound work being done in this line in America than some might suppose, though not on such a large scale as in Europe, it is true. It is a remarkable fact how very quiet some of the companies doing such extensive and prosperous work in Europe have been on the subject. I can quite understand how it is possible that "American Electrical Engineer" might very easily have missed seeing some of the large plants. I remember an instance of one of the largest existing accumulator plants of which I had never seen any accounts or publications and which I discovered by accident. Upon doing so I inquired of various people who, one would think, ought to have known something of it since they lived within but few hours' journey by rail, and to my surprise they had never heard of it. The fact is that when a substantial company is doing a good, honest and profitable business, where the stockholders look upon their holdings as investments, they are not so anxious to "noise abroad" the fact.

At the present day Europeans have learnt and Americans are quickly learning that the best batteries, and the only ones to be relied upon, are those which have a record of showing years of successful and profitable work. These are to be found at the present day and when they come to America it will be with all the advantage of experience acquired and practical details already worked out. I anticipate before very long to see some very large central station accumulator plants in America in which it will not be a case of having to wait before proving that success is possible, as this has already been done. And if Americans cannot do in this line just as well, if not better, what English, French, Germans and Austrians and every other nation has, then I shall "forevermore hold my peace" on the subject of using storage batteries in central stations in America.

DEVELOPMENT IN ELECTRIC METAL WORKING.[1]

BY FREDERICK P. ROYCE.

THE author described the principle of the electric welding by the Thomson, or incandescent, and the De Meritens, or arc system, and gave a brief historical sketch of the art of electric metal working since its first commercial application in 1888. The comparative cost of the electric and forge methods for carriage manufactories was then taken up.

The two important elements of electric welding are, he said, the labor at the welder and the power to drive the dynamo. The man who attends to the engine in all factories can easily look after the dynamo also, and only one man is required for ordinary work on the welder, with possibly a boy to assist him. In heavier work, such as axles, two men, one to weld and the other to reduce the burr under the hammer, can readily turn out 150 sets of one inch axles in a day, while 700 to 800 light tires per day can be welded by one man and a helper at low wages. Grinding and rolling were formerly tried to reduce the burr, but both proved unsatisfactory, and now hammering is found to be the cheapest and most effective method. A light power hammer is ordinarily used, though hydraulic presses have proved satisfactory in some classes of work.

The removal of ordinary oxides and particles of foreign matter has also been found unnecessary, though where heavy red oxides or serious accumulations of other substances exist, the metal should be cleaned. Pickling is resorted to where large quantities of metal are to be welded.

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[1] Abstract of a paper read at the Buffalo Convention of the Carriage Builders' National Association.

The actual horse-power required is 25 h. p. for 45 seconds in the case of a round axle one inch in diameter, or 30 h. p. for 48 seconds for an axle one inch square. From this the cost of welding can be calculated where the price of fuel and labor are known.

The cost of the fuel used under boilers to produce electric current is almost always practically the same as that of the fuel used in forges for the same amount of work.

AN IDEAL CENTRAL POWER STATION.[1]—I.

BY C. J. FIELD, AND THE ENGINEERING STAFF OF THE FIELD ENGINEERING COMPANY.

It was with some reluctance that we accepted the title of this paper, realizing all that the words imply and the difficulty of fulfilling their requirements. We therefore have tried to carry out the idea as fully as possible by taking as a design a type of station which seems to indicate more fully than anything else the latest and prospective development of the best practice in central power stations.

We will, therefore, take the subject up and divide it into several different heads or divisions, and try in general to indicate, by the plans and specifications illustrated herewith, what we believe to be an ideal central power station, and will treat it by giving a brief general outline of the several points and close it by attaching to the paper what may be termed a sort of general specification covering the important points—as building, engines, boilers, generators and piping.

UNIT OF POWER.

The unit of power to be selected for the central power station is one of the first and most important elements to be considered after deciding on the capacity of the station. We have selected for this ideal station 6,000 h. p. as the total capacity. The question immediately arises, how many units of power shall it be divided into? We have found the following as a good rule to follow in deciding on the size of units, and that is, the number of units in any power station shall be the fewest consistent with safe and economical operation of that station. This shall be our foundation stone to build upon, and should be followed in the broadest possible sense. Experience has too often proved that power stations have been divided into too many units. This has been occasioned largely by two reasons: First, uncertainty of the development of the capacity of the station; and, secondly, inability or inexperience of manufacturers in the development and building of large generators.

The business now of building power stations and manufacturing the apparatus has reached such a commercial stage of development that both of these factors are eliminated. We now find capital ready and willing to invest in large power station enterprises, both for railway and general power work; also manufacturers with experience in machinery and ability to develop and build any commercial size of generator required or called for.

The unit of power should be proportionate to the size of the station, and in the size of station we selected we believe a 1,000 h. p. unit to be one which fulfills our requirements in every respect, both for safety and economy in operation. The engines are so built that where a small amount of power may be required for light loads late at night, the engines can be operated with economy on reduced capacity, even down to a few hundred horse power. This removes the necessity for one or two small units as has been customary to install in some stations of this class of work. They, as a rule, fill the space which could be taken by a larger size generator. A larger number of units proportionately than here laid out means additional expense in handling and caring for the machinery, also additional building space and real estate. The problem is now to concentrate all power into as few units as practicable.

DIRECT CONNECTION OR BELTING.

The problem is still in the minds of many people whether to use generators directly coupled to engines, or belted as in the earlier type of station. Formerly we had no choice in the matter. Generators, except in a few cases, were not built in this country for direct connection work in a commercial sense. We could only belt to the engine directly or through counter shaft. We do not propose to go into any extended controversy or argument on the three styles of connections, but only point out a few facts to be considered in this connection before deciding.

In a power station of the size herein indicated and located, as would generally be the case, in or about a large city, entailing considerable expense for real estate, and more expense for the building, the problem which at first reaches the engineer's mind is how to concentrate this power within as small a space as practicable without crowding, and also to economically operate the plant.

Looking at it from this point of view, the relative space required is, roughly, as two to one; in other words, a belted plant would require about five square feet of floor surface per horse power as against two and one-half square feet with direct connection plant. This means a saving of one-half the cost of real estate in building and also concentration of the power for handling. On the other hand, we have not secured flexibility of connection between the engine and generator, which we have in the belted plant, and the relief to the engine which is afforded by belt against the shocks of short circuits, etc. These are facts which should be more fully considered than they have been in the designing and building of a proper type of engine for direct connection. Ample fly-wheel capacity is one of the most important requisites for such an engine and ability to withstand direct shocks of short circuits and overloading of the generators. When these problems have been fully met, both theoretically and practically, we have no doubt that the development of the direct connection station will be rapidly extended. At present we are just beginning to enter what might be termed the era of direct connection work commercially, having as a basis for experience small practice in this country in special cases and a more extensive practice in Europe in this line.

POWER STATION BUILDING.

For power station building there are shown in Figs. 1, 2 and 3 general features and details of construction of a building adapted for this style and capacity of station.

The power station building is a factory for producing a commercial commodity and should be treated in that sense, the essential requirements being solidity of construction and protection against fire or any other accident to the machinery contained therein. The design of these buildings is too often placed in the hands of local architects, inexperienced and unacquainted with the requirements of such a building, and we find as a result many power stations in which the machinery has to be placed to fit the building, instead of, as it should be, the machinery laid out and the power station built to cover and properly protect it; being built, therefore, from an engineering point of view instead of an architectural one.

Without attempting to go into details or producing a regular building specification, we have tried, under the head of "Suggestions for Building Specifications," to cover the main features required in such a building.

BUILDING SPECIFICATIONS.

Excavation.—Excavate the entire space under the engine room to a depth of 10 feet, so as to get clear head room of 8 feet in basement. Excavate for all side, cross and gable walls, all foundations, and also central space between boilers to form a basement under the boiler room for ash and coal handling apparatus, flue and pipes.

Foundations.—If ground is good, lay base of concrete (four broken stone, two sharp sand, one hydraulic cement) and make footing courses of brick work or coursed rubble masonry of good, firm building stone, laid in cement mortar of three parts sand to one part cement. In case piling is necessary, test piles should be driven on different parts of the property in order to determine the bearing capacity of the pile under the conditions present, noting the amount the pile sinks under the last blows of the "monkey." Allow a factor of safety of from 4 to 15, depending on the conditions present. Piles should be of hemlock or spruce, perfectly straight and round, a 40-foot pile having not less than a 12-inch butt—the piles, after being driven, to have heads sawed off below mean low water to a uniform level; all piles in water to be capped with granite foundation stone, while those with heads in earth to be capped with a grillage of 12 x 12 spruce and 3-inch plank timber, and the whole filled with concrete well rammed. Lay foundation proper on this grillage.

Walls.—All walls should be of brick work from 16 to 20 inches thick, with pilaster at each roof truss, having at least 8 inches projection and 24 inches face. Carry these to a height of at least 25 feet, so as to allow clear head room of at least 20 feet below the traveling crane in power house. All brick should be burned and should have clean, sharp edges, no salmon or light-colored bricks being allowed. All brick work should be laid in cement mortar. The cement should be Dyckerhoff's or English Portland. All bricks in the face of the wall should be selected. All joints should be pointed. Pilasters on side walls of engine room should be built out by offsets and capped with stone binder for carrying rails of traveling crane. Set side ventilators in walls near ground line.

Roof.—The roof should be iron truss, riveted type, furnished with iron louvre, with side ventilator that can be operated from the floor. The top of louvre should be furnished with heavy hammered glass. The roof should be covered with Norway pine plank, splined and then covered with black slate of good quality laid with not more than five inches to the weather. All flashing around walls and all gutters to be of 16-ounce copper. The whole to make a weatherproof job.

Engine Floor.—The engine floor should be of two layers of plank, the first of yellow or Norway pine splined with hard wood, this floor to be covered with about one-eighth inch of plaster and with a second floor of seven-eighths inch second quality maple laid at right angles to the first. The first plank to be not less than eight or more than 12 inches and securely bolted by hook bolts at every beam to the iron I beams. The second floor should not be over four inches in width and should be blind nailed. All plank should be neatly fitted about all foundations and hand planed and smoothed and finished with two coats of boiled oil put on warm.

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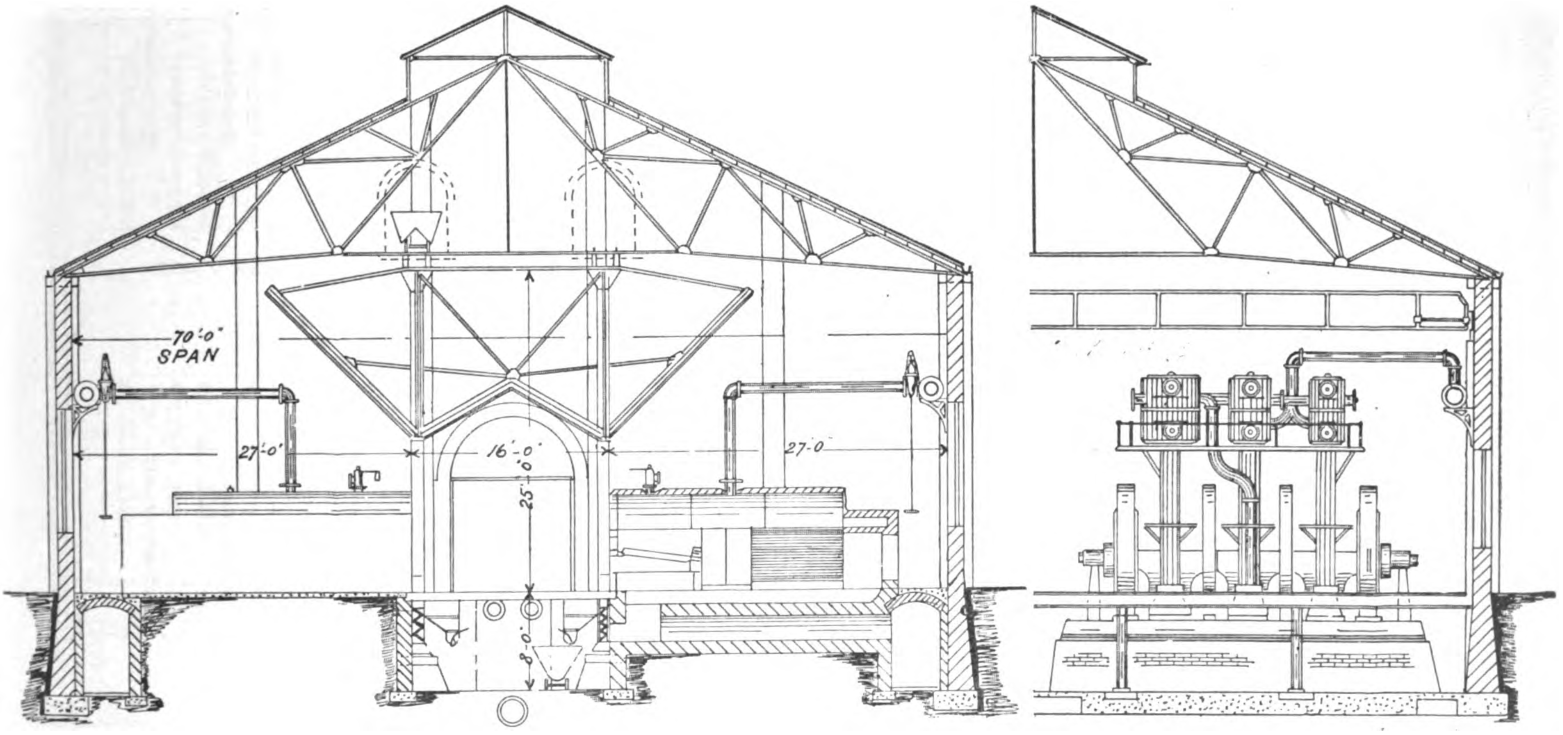
[1] Read before the Chicago Electric Club, December, 19, 1892.

Engine and Boiler Room, Basement Floor.—This floor should be made of not more than six inches concrete, well rammed and graded to drain, and finished by means of fine stuff floated smooth by means of a hand trowel.

The boiler room floor between boilers should be made of steel I beams covered by means of cast iron plates of suitable pattern. All other parts of the fire room should be finished by means of concrete cement same as basement.

Doors and Windows.—All floors or main doors should be of some wood ceiling and made, say, 2½ inches thick and finished with large wrought iron hinges (oxidized hinges and knobs). All doors in cross or partition walls should be made of beaded white pine ceiling laid diagonally and securely nailed, covered with a layer of asbestos board and then entirely covered with black sheet iron fastened by means of round-headed nails. These doors should be sliding with friction rollers, track, etc. All windows should have box frames and all sashes have four lights of American glass, best quality, well bradded and back puttied, fitted with noiseless pulleys, cast iron weights, brass chains and sash locks.



SECTION OF BOILER AND ENGINE ROOMS, FIELD IDEAL STATION.

Painting.—All woodwork should have not less than three coats of first-class lead paint ground in oil; this includes under side of roof, windows, doors, etc. All iron should receive two coats of metallic paint, one before erection and one after the structure is completed.

ENGINES.

Engine manufacturers and designers to-day are devoting their best time and attention to the development of a type of engine best adapted for electrical power work. We find, therefore, more progress being made this year and still more promise for the year to come than has been made in a number of years on this work. The old high speed engine has done well and the Corliss engine too. Present work and requirements seem to tend to a type of engine combining, it might be said, the good features of both, filling a middle ground and adapting itself more fully to the demands and requirements of large central station work with direct connection. Engines meeting these requirements are now being built and manufactured by such firms as the Lake Erie Engineering Works, Dickson Manufacturing Company, Cramp & Sons' Ship and Engine Building Company, Pennsylvania Iron Works Company, McIntosh & Seymour, E. P. Allis and other builders. We have tried to indicate the requirements of such an engine in the following specifications:

ENGINE SPECIFICATIONS.

Duty.—Electric railway and power work. All parts extra heavy.

Type.—Vertical, three crank, triple condensing.

Power.—Ability to develop for short periods of time a power of at least fifty per cent. above its rated capacity without dropping off in speed of revolution.

Regulation.—Regulation effected by means of a shaft governor acting on the valves of high pressure cylinder alone. Governor designed to cut off all lead of steam valves when practically all load is thrown off the engine. The momentary variation of speed of revolution (*i. e.*, the variation that would take place in three to five seconds) not to exceed 2½ per cent. when one-half of the rated load of the engine is thrown suddenly on or off; indicated by means of a tachometer belted direct to the engine shaft.

Economy.—Economy with condenser under average economical load, to be not more than fourteen (14) pounds of steam per indicated horse power per hour with 150 pounds initial steam pressure and 26-inch vacuum. This assumes that the steam is not to exceed 2½ per cent. of moisture and the first cylinder steam jacketed with full boiler pressure.

Valves.—To have four valves to each cylinder. The steam and exhaust valves to be independent, with exhaust valves moved by separate gear. Valves on high pressure cylinder to be either of the piston type or flat valve, balanced, with pressure plate. Valves on intermediate pressure and low pressure cylinders to be of flat type, either four ported, partially balanced grid-iron or Corliss type.

Clearances.—Clearances not to exceed eight per cent. in the high pressure cylinder and three per cent. in the intermediate and low pressure cylinders. Cylinders to be protected by non-conducting covering, such as magnesia or asbestos, and steel or cast iron jackets for finish. Cylinders in receivers to be protected by means of relief valves.

Frames.—To be castiron girder-type " *A* " frame.

Shaft.—Of best forged steel with built-up cranks and counterbalanced in one piece.

Bearings.—All main bearing surfaces such as shaft bearings, slides, etc., should be water jacketed.

Gallery.—Engine to be furnished with one or more galleries from which it can be operated as well as from the floor, and offering easy and safe means of access for lubrication and inspection.

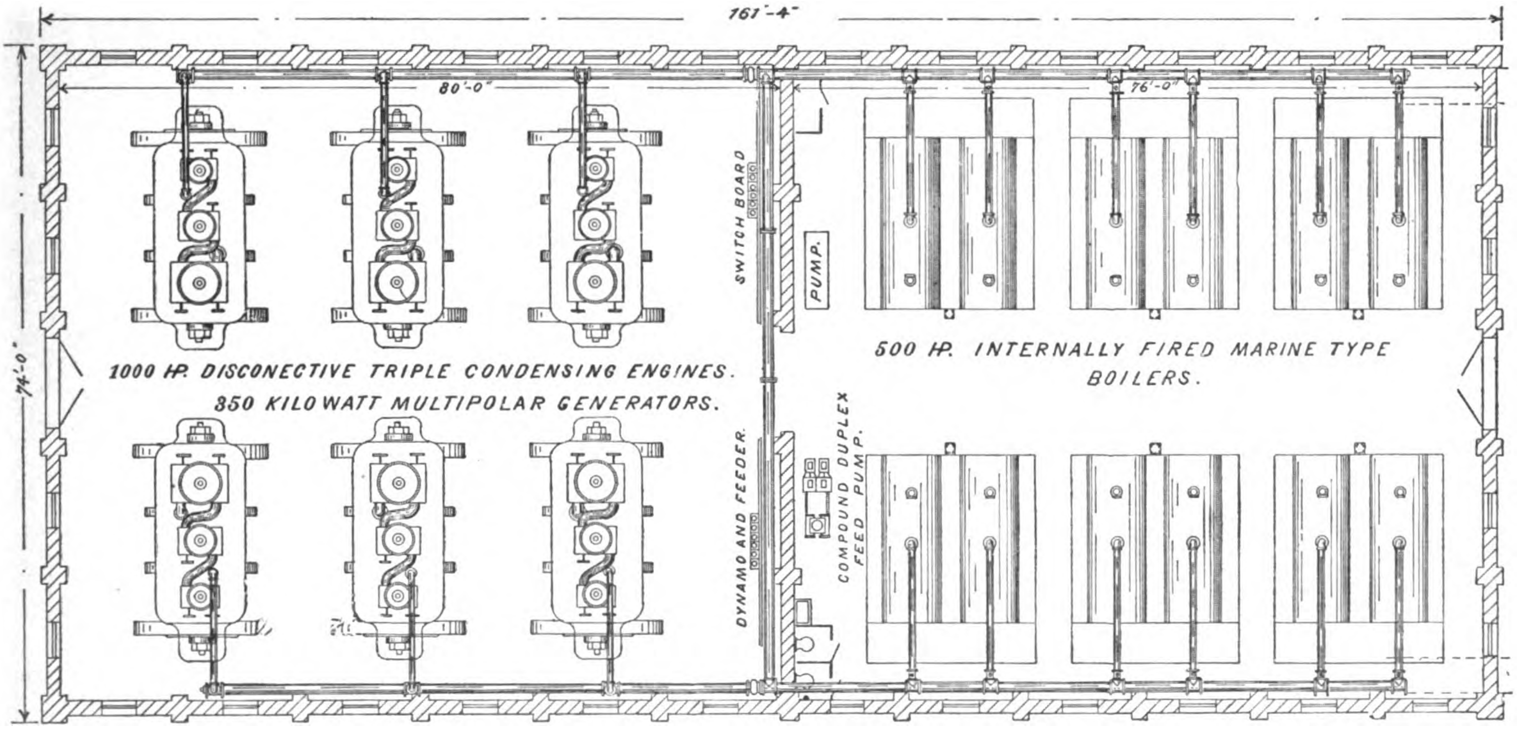
Lubrication—Engine to be provided with either oil or grease lubricating apparatus, such that it can be lubricated as thoroughly when in motion as when at rest. Each cylinder to be provided with sight feed lubricators as well as oil pumps, and the entire engine, if oil is used for lubrication, to be fitted with sight feed lubricators. In the case of grease lubrication, provision is to be made to allow any part to be lubricated individually, as any system of grease distribution from a common centre involves the possibility of stoppage of tubes with dirt or foreign substances.

Fly or Belt Wheels—The engine should be provided with intermediate wheels between the cylinders where possible, so as to bring the shaft as near the condition of uniform load as possible. Allow 48 pounds per indicated horse power in the case of electric lighting and 70 pounds in electric railway and power work for weight of fly wheels. Rim of wheels on a basis of 5,000 feet velocity of the rim per minute. Piston speed 650 feet per minute.

Rotative Speed—A mean figure between a high, or what is commonly understood by high, and low speed; say 120 revolutions per minute on a 750 h. p. triple.

Remarks—The power the engine should develop when connected direct to an electric generator should be determined by the capacity of the generator first, and also its capacity for overload. The engine should have an ultimate capacity approximating that of the generator.

Experience has proved that an engine of large power can be regulated closely as regards speed of regulation, by means of a shaft governor acting directly on a properly designed valve and gear on the high pressure cylinder alone of a triple expansion engine. The governor should have a "gravity balance" in case the steam valve on the high pressure cylinder is placed in such a position that it is free to move vertically, as is generally the case in this type of engine. The governor should also have a centrifugal or "running balance" when the engine is in motion. As mentioned in specifications, the governor should be designed to cut off all lead of the steam valves operated by the governor, so that when practically all load is thrown off the engine, the governor will admit absolutely no steam to the high pressure cylinder, thus compelling the engine to decrease in speed by having only the remaining speed in the first and second cylinders to draw on, instead of the amount that would be admitted by the lead of the high pressure cylinder valves, as usually done to-day.


161'-4"
80'-0"
76'-0"
74'-0"
SWITCH BOARD
PUMP.
500 HP. INTERNALLY FIRED MARINE TYPE BOILERS.
1000 HP. DISCONECTIVE TRIPLE CONDENSING ENGINES.
350 KILOWATT MULTIPOLAR GENERATORS.
DYNAMO AND FEEDER.
COMPOUND DUPLEX FEED PUMP.

PLAN OF ENGINE AND BOILER ROOMS, FIELD IDEAL STATION.

The specifications for valves in the engine described follows logically when the regulation of the engine is obtained by means of a shaft governor, acting directly on the high pressure steam valves without the intervention of any intermediate gearing to assist the centrifugal force of the governor, thus depriving it of its sensitiveness with changes of speed. The piston type of valve is open to the objection of leakage, but inasmuch as any leakage would be expanded in the next two cylinders of a triple, the simplicity of the valve and its action under high pressure steam tends to balance this argument. It is essential to have the valve balanced on account of the high steam pressures used in this cylinder. The valves on the intermediate and low pressure cylinders, as already specified, would give a practically perfect steam distribution when moved by the eccentrics, and the engine can then be adjusted to the service required, be it condensing or non-condensing.

One of the most vital points of an engine for electric service is that of main bearings. They should have a surface velocity of not exceeding 350 feet per minute, with a mean bearing pressure per square inch of projected area of journal of not more than eighty pounds. This is considerably within the safe limit of cool performance and easy operation. If the bearings are designed in this way, it would admit of the use of grease on all the main wearing surface, which in a large type of engine for this class of work we think advisable.

In regard to the location of fly or belt wheels, we said in the specification that the engine should be provided only with intermediate wheels between the cylinders, so as to bring the shaft within the condition of practically a uniformly loaded beam. This will prevent excessive wear on any one main bearing of the shaft, and in that way allow it to become other than a straight line.

In regard to rotative speed it is a mutual condition between the engine and generator, and is too often determined by financial considerations. The faster speeds permit less cylinder condensation in the engine, but require a greater amount of care in the engine-room. The tendency to change among large engines of the type for which we are furnishing specifications is toward the medium rotative speed.

CHOKING COILS.

THE London *Electrical Review* says: There is eddy current loss of power in all the conducting masses of a choking coil. Hence a choking coil is really a transformer with one primary coil and many secondaries and much magnetic leakage. In a transformer with many coils, whether or not they have magnetic leakage, it may be shown that any given group of secondaries of a given number of turns and resistances may be replaced by one secondary without affecting the currents in the other coils; and we may take a choking coil to be a transformer with a primary coil of N turns, and resistance R ohms, with C amperes flowing at any instant, the potential difference at its terminals being V, and a secondary coil closed on itself of n turns, resistance r ohms, and current c amperes. The Proceedings of the Physical Society for October contains a valuable Note by Prof. John Perry, D.Sc., F.R.S., with an indication that we may shortly expect further contributions from him upon this interesting subject of choking coils. The treatment in this preliminary note is of a mathematical nature; equations being deduced which it will be useful to compare with those which are employed in practical transformer calculations. The Professor towards the end of his paper throws out the suggestion that in a choking coil we have, perhaps, found what has long been looked for—a method of increasing frequency by magnetic means.

THE STATUE OF LIBERTY.[1]

BY MAJOR D. P. HEAP, U. S. A.

WHEN the Statue of "Liberty Enlightening the World" was erected on Bedloe's Island, New York Harbor, it was found that no provision had been made to show a light, except possibly through the windows forming the diadem.

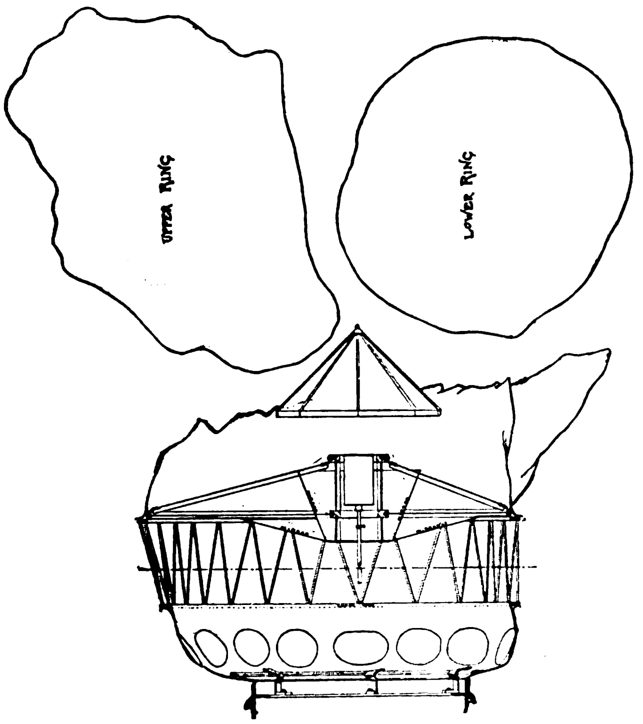
The statue consists of an iron skeleton covered with a copper skin, and stands on a granite pedestal in the centre of Fort Wood.

In the daytime it is a most commanding figure, as it is of colossal size, the combined height of pedestal and statue being three hundred and five feet.

At night it would be invisible unless illuminated by artificial means. The very name of the statue almost imperatively demanded that it should exhibit a light, and, as the right hand carries a torch from which flares an immense copper flame, the most natural thing to do was to make the flame luminous.

Various methods were proposed. One was to place electric lights on the balcony surrounding the flame, which by reflectors would throw their light on the flame, while the direct light would be screened from the eye of the observer.

This might have answered fairly well had the flame been gilded; but a serious objection was that these outside lamps would be exposed to all weathers.



NEW TORCH OF THE STATUE OF LIBERTY.

On Oct. 11, 1882, Lieut. John Millis, Corps of Engineers, U. S. A., proposed a plan contemplating exhibiting a powerful electric light from the torch to be visible around the entire horizon, and such an arrangement of lamps and reflectors at the salients of the fort as to throw light directly on the statue and pedestal, besides the necessary illumination of the interior of the statue and pedestal and the engine and boiler-rooms.

In order that the light placed inside the torch could be seen, it was necessary to provide openings; so two rows of circular windows, like the port-lights of a vessel, were made in the copper flame. This plan was approved, and was so promptly carried into effect that everything was in readiness for the inauguration ceremonies, which took place on November 1, 1886. Mr. Bartholi visited the island on that night, and expressed himself as entirely satisfied with the effect of the illumination. He appreciated the difficulty of making the statue itself visible by reflected light, owing to its dark color, and had certain other ideas in addition in regard to its illumination.

After quoting letters from Mr. Bartholdi, in which he suggests, among other things, placing a supplementary light in the head of the statue, Major Heap continues:

Experiment has shown that the project of placing a light in the head does not have the effect anticipated by Mr. Bartholdi: the appearance is simply that of another light below the one in the torch.

The effect of the side-lamps is to illuminate quite satisfactorily the pedestal, which is of a light-colored granite, and to bring out the details of the statue when the observer is close to it.

If the statue were painted white it would be seen very clearly, and I believe the effect would be very striking, especially at night, and in addition it would check the corrosive action of the copper, which has already taken place, as is shown by the green streaks on the pedestal.

I was anxious that the method of lighting should be improved, and at the same time to carry out as far as practicable the ideas of the artist.

I submitted my views to the Light-House Board. They were approved; and in consequence the following notice to mariners was issued:

> Notice is hereby given that, on or about October 21, 1892, the following changes will be made in the lights and illumination of the Statue of Liberty Enlightening the World, inside Fort Wood, Bedloes Island, New York Bay, New York.
>
> In addition to the light now shown from the torch there will be a vertical beam of red and yellow light seen only by reflection from the haze or dust in the air.
>
> The face and bust of the statue will be illuminated by a powerful search light from one of the salients of the fort.
>
> The coronet will be decorated with red, white, and blue incandescent electric lights.
>
> The pedestal will continue to be illuminated as heretofore by arc lamps within the salients and not visible outside the fort.

As will be seen by the notice to mariners, the day for the first exhibition of the light was that set apart by the President as a national holiday. The flame originally contained eight arc lamps of about 2,000 c. p. each, and these could be seen only through the circular windows previously mentioned. Of course a very large proportion of the light is wasted, and the observer can see only that which streams through that window opposite to which he happens to be. These eight lamps are now replaced with one self-focussing lamp of 6,000 c. p., and for the circular windows is substituted a glazed belt of plate glass eighteen inches high.

Inside the flame are mirrors made of aluminum reflecting a portion of the light horizontally and the rest of it in a vertical beam through a skylight glazed with red, white, and yellow glass, the different colors giving it somewhat the effect of a flame.

The aluminum mirrors are corrugated, and the light reflected from their numerous faces seems to be of a diameter as large as the copper flame, and no longer looks like a bright point or star.

The making and fitting of the frame to hold the glass forming the glazed belt was the most troublesome and difficult part of the whole plan. It was done by first making patterns of the flame where the upper and lower rings were to go. These rings were then made in four pieces and fastened securely outside the flame to the iron frame inside by means of bolts passing through the copper.

After this was done, brass sash-bars were screwed diagonally to the rings, the copper was then cut away between the rings, and the glass panes put in.

The accompanying diagram will show how irregular in shape these rings had to be, and how difficult it was to fit them.

The lighting of the coronet or diadem was considerably simpler. Fifty incandescent lamps of 50 c. p. each are used, and the globes surrounding them have the national colors. There are twelve red lights in the centre, then six white ones on each side and thirteen blue ones over each temple. The effect is that of a crown of jewels composed of rubies, diamonds and sapphires.

NO SATISFACTORY BID FOR THE NEW YORK UNDERGROUND.

THE franchise for the proposed elaborate underground rapid transit system in New York city was put up for sale on Dec. 29, at the City Hall but only two bids were made, both coming from the same person, Mr. W. N. Amory, who offered $500 and $1,000, with ⅛ of 1 per cent. on the gross receipts of operation. The bid was not accepted. It is now expected that the Manhattan Elevated Company will make an alternative proposition, whether the franchise should or should not be put up again, on the underground plan. The road was to be run by electricity, but there is consolation in the fact that its non-construction will only necessitate further resort to the use of trolley cars. It is also likely that the elevated railway extensions will have to be operated electrically.

IMPROVEMENTS IN THE NEW YORK POLICE TELEGRAPH.

THE Board of Estimate and Apportionment has given $47,000 to the Police Telegraph Department, the greater part of which sum is to be used to make a complete change in the telegraphing system. A year ago this department asked for $72,000 for this purpose, but got only $25,000. The appropriation now made completes the amount originally asked for, and the change will be effected at once. M. R. Brennan, at present assistant superintendant of the Police Telegraph Department, but who will become the superintendent-in-charge after January 1, states that the system which is to be put in use is practically that of the Stock Quotation Telegraph Company.

Mr. Brennan will have Mr. E. H. Murphy as his assistant superintendent. The respective salaries are $3,000 and $2,000 per annum.

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[1] Abstract of an article in *Lippincott's* for December, 1892.

LETTERS TO THE EDITOR.

THE COMPOUND AND THE VARIABLE SHUNT MACHINE.

In your Dec. 21 issue, I note a letter from Mr. J. Stanford Brown in regard to compound wound machines. He opens his letter with this statement: "Let us have a little light on the subject of the variable shunt on the series field." It strikes me that, to use his own expression, he has "let very little light" on the subject by his letter. I do not wish to pose as a champion of the Thomson-Houston, or any other machine, but as an electrician, it seems very strange to me that anyone having the familiarity with the Thomson-Houston machine which Mr. J. S. Brown appears to have, could write such a letter on the subject under discussion, for he seems to overlook or ignore the usual object of shunting a series coil.

According to my way of thinking, it is a clear proof of a well designed machine if the so-called variable shunt can be removed from the series coil without "appreciably bad results," for its object is, not to waste a large number of watts, but to correct a very slight possible error in the ampere turns of the series coil,—an error not owing to fault of design necessarily, but rather, in the main, to the conditions which tend to make dynamos, particularly where cast iron enters into their construction, vary slightly in their electrical conditions.

This variation in well designed machines, should not exceed more than from 1 to 1½ per cent., and under any circumstances, not over 2. Now it is perfectly evident that a variation of 2 per cent. in the E. M. F. of the dynamo is, under ordinary circumstances, not going to cause "appreciably bad results." On the other hand, if the machine is sold and guaranteed for a certain E. M. F. the makers certainly want to make it right, even as close as within 1½ per cent.

Of course the remarks I make refer particularly to constant potential, incandescent dynamos and not to special machines which, for some good reason, are over-compounded. It is very evident to any electrician that shunting the series coil of a properly designed dynamo *will* vary the E. M. F. given out by the machine under part or full load and that the E. M. F. will rise or fall according as the resistance of the shunt is high or low, in proportion to the resistance of the series coil. If Mr. Brown found no variation on removing his so-called variable shunt, it certainly showed that the machine with which he was experimenting was unquestionably well designed, without having loss of energy wasted in watts or more pounds of copper in the series coil than was necessary to do the actual work required.

Mr. Brown evidently confuses the types of dynamos under discussion, having performed his experiments on standard machines, designed for constant E. M. F. and forgetting that it is often a great advantage in special cases to have a machine so designed that the E. M. F. can be maintained or varied at will, as the load is increased. This last condition is where the variable shunt to the series coil gets in its work. In the machine tested by Mr. Brown, the shunt, evidently, was not intended to be *variable*, but was adjusted once for all, and was supposed to be left to remain so.

I trust that I have made myself clear, and thrown a "little more light" on the subject under discussion.

J. F. Denison.

New Haven, Conn., Dec. 24, 1892.

THE EFFICIENCY OF ALTERNATING CURRENT PLANTS.

In your issue of Dec. 14, W. H. C. propounds a question upon station design and management which is not peculiar to his own plant. He finds a discrepancy between the station load, and the commercial value of the service given.

His first complaint, that the dynamo was supposed to supply five amperes for each 100 lights, is probably the result of misleading statements of an agent. It is possible to obtain this result, if lamps only are connected to the dynamo, without loss in the circuits, but the statement does not cover commercial conditions, including primary and secondary circuits and converters, each of which is a source of loss.

His assumption that 750 lamps on the secondary circuit, can be operated with 75 I. H. P., is hardly possible in practice under his conditions. He says that 97 converters supply 1,300 lights, an average converter capacity of less than 15 lights, and it is most probable that this size of converter or smaller is in the majority. Taking the above figures I think he will find the engine will indicate 80 H. P. at least, and most probably more, when 750 lights are "on." Calculating the efficiency of the plant on the basis of 50-watt lamps, it gives about 68 per cent., or a loss of 37 per cent. between the engine cylinder and the lamps. This loss may be divided about as follows: Engine and belt, 14 per cent.; dynamo and exciter, 15 per cent.; distribution, 8 per cent.

A large part of the loss which W. H. C. cannot locate is probably due to the use of so many small converters. These are known to be of lower efficiency than large ones, and besides this he has a large amount of iron upon the circuit which dissipates current as heat, and consequently this current which is recorded at the station has no commercial value. This loss becomes more serious to a plant with a long period of light load, and a short one of heavy load, as it does not vary with the load.

There is another point affecting the commercial value of a plant, which W. H. C. does not touch, but it may not be out of place to refer to it, and that is, the voltage used. I prefer to use 2,000 volts primary, and 100 volts secondary, and in most cases these conditions will improve the commercial value of a plant, taking only one-quarter the amount of copper to operate at the same loss; or the copper may remain the same and the loss reduced, the efficiency of all the apparatus remaining practically the same. Some people object that we cannot insulate 2,000 volts, but this I do not admit, as I have installed several plants of this type, all of which are successful. Even admitting this objection, there is no objection to 100-volt secondaries, and the consequent saving of copper. It is true that with 50-volt secondaries and lamps, the electrical efficiency is slightly higher, 13 per cent. as a maximum under the best conditions, but having regard to the large saving in copper and the first cost of installation, and, therefore, the smaller receipts required to produce a dividend, I think the balance is decidedly in favor of the higher voltage in most cases. Another point concerning 50-volt wiring is that generally the fittings are ill suited to carry the larger current necessary, and there is more heating of parts, especially fuse boxes, where fuse wire is used.

I have recently seen an aggravated case of W. H. C.'s complaint, where no larger converter than 15 lights had been ordered, and only a few of these. In this plant I have seen three and four converters bunched to supply a building.

Nemo.

THAT UNREMUNERATIVE ALTERNATING PLANT.

I wish to thank your contributors C. M. Green, A. W. Meston, and "N. W." for the information contained in their letters printed in The Electrical Engineer of December 28, as well as the correspondents whose private letters I have received through you. By an oversight in my former letter, the actual number of transformers, which is 77, was printed 97. These are as follows: 24 of 10-light: 31 of 20-light; 17 of 25-light; and 5 of 40-light, making an aggregate lamp capacity of 1,485. The lamps are 52-volts. In accordance with a suggestion of one correspondent, I tried the experiment of running the plant in the day-time with no load, and got an indication on the ammeter of over 12 amperes. Taken in connection with a computation similar to that given by Mr. Green, this led me to suspect a special leak. I set the dynamo running and disconnected one transformer after another, and finally found a defective one, the removal of which caused the reading to drop to about 3½ amperes. This was evidently the main source of the trouble. A comparison of the readings of a 40-light meter, which I placed in the 1,000-volt circuit with the station ammeter, indicates that "N. W." is correct in his statement that the power is liable to be overestimated when computed from the ammeter readings. The load which has been taken off from our dynamo does not compare with the load which has been taken off my mind.

W. H. C.

December 29, 1892.

PERSONAL.

MR. W. FORMAN COLLINS.

It is with mingled feelings of regret and pleasure that The Electrical Engineer announces the severance of its connection with Mr. W. Forman Collins, who for more than two years past has been its Western Editor and Manager. There are few electrical engineers of the same age his equal in ability and experience, and he has shown a judgment and a capacity for hard work that will help to carry him far on the road to success. He is still very young, but in the favoring air of Chicago has ripened quickly, winning his position by downright merit. He will now join the forces of the *Western Electrician* under such desirable conditions that the Engineer can only congratulate him and wish him God speed. His new duties connected with the active direction and management of our prosperous Western contemporary will bring him heavier personal responsibilities than heretofore, but he will be found in every way equal to the emergency; and he will in his larger sphere of usefulness and activity, broaden and develop in all the good qualities that have already taken him so quickly to the front of Western journalism.

Mr. H. T. Edgar, who has been connected with the New York Engineering Department of the General Electric Co. has resigned his position, and on January 1, will become manager of the Georgia Electric Co., of Atlanta, Ga. He will have charge of one of the largest and best plants in the South.

Mr. John A. Cross, consulting mechanical and electrical engineer of this city, has accepted the position of manager of the Geneva, N. Y., electric lighting station, and will shortly enter upon his duties.

OBITUARY.

CAPTAIN ALBERT GALLUP.

We regret to record the death of Capt. Albert Gallup, formerly Park Commissioner in this city, and late in command of the Signal and Telegraph Corps of the First Brigade, National Guard State of New York. He took charge of the Corps a few years ago and had made it into a scientific military organization of very high efficiency. Its excellence was shown at Buffalo during the strikes last summer, when he established a military telegraph service, which was of the greatest service and importance, and for which Capt. Gallup was complimented by the authorities. The corps consists of telegraphers, electricians and engineers. Mr. Edward B. Ives, E.E., was his first lieutenant.

LEGAL NOTES.

INCANDESCENT LAMP LITIGATION.

THE WESTINGHOUSE COMPANY ENJOINED UNDER THE EDISON PATENT.

The hearing on the application of the Edison Electric Light Co. for an injunction restraining the Westinghouse Company from manufacturing incandescent lamps infringing the second claim of the Edison patent, took place before Judges Acheson and Bunnington of the United States Circuit Court at Pittsburgh, December 27. The defendant company filed a general denial of the bill, which claims that the Westinghouse Company is continuing to manufacture and sell infringing lamps.

The court decided to follow the form of the decree of the Circuit Court of New York in the Sawyer-Man case, and an order was so made.

SOCIETY AND CLUB NOTES.

CONNECTICUT ELECTRIC LIGHT ASSOCIATION.

The third annual meeting of the Connecticut Electric Lighting Association, comprising 14 companies, was held at Waterbury, Ct., Wednesday afternoon, Dec. 21. The objects of the association are to promote a better acquaintance and for the discussion of improved methods of electric lighting. These officers were chosen: President, James E. English of the New Haven Electric Lighting Company; first vice-president, James A. Hadley of the Meriden Electric Company; second vice-president, James P. Stow, manager of the Middletown Electric Company; treasurer, John C. English of the Bridgeport Electric Company; secretary, A. M. Young of Waterbury. These officers, with L. C. Whitney of New Britain and Fred Fuessenich of Torrington form the executive committee.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED DECEMBER 20, 1892.

Accumulators:—

Storage Battery, G. A. Washburn, Cleveland, O., 488,233 Filed Dec. 10, 1889

Employs perforated metallic electrodes separated by an interposed porous diaphragm and insoluble active material permeated with an electrolytic solution.

Alarms and Signals :—

Railway Signal, E. Schaefer, Lynchburg, Va., 488,225. Filed Aug. 26, 1891.

An automatic electric signal for steam railways.

Signal Repeater, T. H. Patenall, Rahway, N. J., 488,285. Filed Jan. 2, 1892.

Consists of the introduction of an audible signal in connection with the visional repeating signal to warn the operator in case the signal fails to complete its stroke.

Fire Alarm Apparatus, A. G. Davis, Baltimore, Md. 488,388. Filed May 27, 1892.

A mechanism which will indicate by single strokes of a gong the number of the signal box sending the alarm.

Means for Operating Station Indicators, R. B. Ayres, New York, 488,415. Filed Sept. 1, 1892.

Consists of electrical contacts supported by the trolley and a movable spring-restored arm, the depression of which automatically closes the contact.

Distribution :—

Electrical Switchboard, J. W. Lyon, Brooklyn, N. Y., 488,532. Filed June 11, 1889.

Claim 1 follows :

An electrical switchboard composed of cards, each consisting of an insulating material moulded about a series of pairs of contact plates forming a series of sockets.

Electrical Distribution Box, W. H. Hart, Brooklyn, N. Y., 488,198. Filed March 22, 1890.

Employs removable sectional bridging pipes connecting the ends of the ducts entering the opposite sides of the box.

System of Distribution for Polyphase Alternating Currents, C. S. Bradley, Avon, N. Y., 488,307. Filed July 29, 1892.

Has the several wires distributed in pairs among a number of lamp circuits, two or more adjacent circuits including all wires of the polyphase system and motor circuits connected with the wires of the several lamp circuits so as to include all of the polyphase currents in the motor system.

Dynamos and Motors :—

Dynamo Regulator, C. J. Bogue, New York, N. Y., 488,261. Filed Feb. 18, 1892.

Invention consists of pole pieces movable circumferentially relatively to the armature.

Electric Motor, C. S. Bradley, Yonkers, N. Y., 488,305. Filed June 23, 1890.

An alternate current motor whose parts rotate in opposite directions, each provided with a differential phase winding such that a relative shifting of the magnetic poles will be effected upon connection with a circuit supplying differential phase currents.

Alternating Current Motor, C. S. Bradley, Avon, N. Y., 488,306. Filed March 15, 1892.

Claim 1 follows :—

An alternating current motor provided with a self starting and a synchronous winding on its armature, the two being arranged in shunt relation.

Lamps and Appurtenances:—

Lamp Socket and Terminal Therefor, J. Hutchinson, New York, 488,205. Filed Feb. 8, 1892.

Employs an insulating base carrying terminals composed of two pieces adapted to grasp a part of the base and a screw for the purpose of clamping them thereto.

Incandescent Electric Lamp Base, F. C. Rockwell, Hartford, Conn., 488,222. Filed Dec. 26, 1891.

Consists of a bottom formed of a single piece secured to the globe and bearing conducting pieces, and a shell formed of a single piece having two longitudinal chambers with one end closed and the other secured to the bottom with wire perforations through the closed ends.

Process of Uniting Broken Pieces of Arc Light Carbons, N. P. Stevens, Concord, N. H., 488,256. Filed July 1, 1892.

Device for Raising or Lowering Suspended Electric Lights, F. P. Welsh, Omaha, Neb., 488,298. Filed June 14, 1892.

Electric Arc Lamp, A. De Puydt, Liege, Belgium, 488,829. Filed Feb. 17, 1892.

Employs a solenoid in a circuit about the carbons carrying a stationary core and a movable core, the latter suspended from two blade springs and carrying contacts controlling the circuit including the field regulating magnet.

Metal Working :—

Electric Forge, G. D. Burton, Boston, and E. E. Angell, Somerville, Mass., 488,466. Filed Oct. 6, 1891.

A forge for the purpose of uniformly heating metal bars from end to end.

Electric Metal Heating Apparatus, G. D. Burton, Boston, and E. E. Angell, Somerville, Mass., 488,467. Filed Aug. 8, 1892.

Provides a non-heating governor for controlling within certain limits the converted current.

Electric Metal Working Apparatus, G. D. Burton, Boston, and E. E. Angell, Somerville, Mass., 488,468. Filed Aug. 31, 1892.

Provides means for conveniently utilizing one main circuit for different arcs, and automatically regulating the current to conform to the number of such arcs in use.

Electric Metal Heating Apparatus, G. D. Burton, Boston, and E. E. Angell, Somerville, Mass., 488,469. Filed Sept. 22, 1892.

Has for its objects to secure a proper distribution to the working circuits and to avoid sudden shocks or changes of load.

Process of Reducing Franklinite Ores, G. G. Convers, Salisbury, Pa., 488,470. Filed Feb. 29, 1892.

Process consists of rendering the franklinite magnetic, separating it by magnets from the willemite and zincite, and reducing the two last to spelter.

Process of Treating Franklinite and Willemite, G. G. Convers, Salisbury, Pa., 488,471. Filed July 25, 1892.

Similar to 488,470.

Miscellaneous:—

Phonograph, T. A. Edison, Llewellyn Park, N. J., 488,189. Filed May 29, 1888.

Machinery for Setting Up Type, J. Hooker, Beccles, England, 488,265. Filed Nov 23, 1891.

An electric type-setting machine.

Coin Controlled Phonograph, H. Hoeschen, Omaha, Neb., 488,278. Filed Oct. 6, 1890.

Induction Apparatus, C. Willms, Baltimore, Md., 488,299. Filed May 7, 1892.

Employs an automatic circuit breaker, a number of induction coils independently operated and controlled by the circuit breaker.

Phonograph, G. Bettini, New York, 488,379. Filed Jan. 27, 1892.

Phonograph, G. Bettini, New York, 488,380. Filed Mar. 14, 1892.

Phonograph, G. Bettini, New York, 488,381. Filed Mar. 14, 1892.

Safety Attachment for Elevators, L. W. Butler, Brooklyn, N. Y., 488,424. Filed Apr. 8, 1892.

Consists of a pivoted and counterbalanced keeper adapted to engage the rope when the door is opened. and an electrical device for moving the keeper in one direction controlled by the opening and closing of the door.

Musical Instrument, R. W. Pain, New York, 488,482. Filed Dec. 4, 1890.

An electrical keyboard for pianos, organs, etc.

Electrically operated stringed musical instrument, W. H. Gilman, Boston, Mass., 488,520. Filed Mar. 9, 1892.

Railways and Appliances :—

Trolley Stand for Electric Cars, E. M. Bentley, Boston, Mass, 488,179. Filed July 20, 1892.

Comprises an upright cylinder containing a rotatable drum carrying a pivoted trolley pole and a spring plunger sliding in the drum.

Closed Conduit for Electric Railways, L. O. Dion, Natick, Mass., 488,351. Filed Nov. 9, 1891.

Employs a fixed trolley track composed of insulated conducting sections on the roadbed, a vertically movable conducting wire located below and normally out of contact with the track, put having a series of loops and a series of magnets pivoted to fixed supports below the track and provided between their poles with supports of insulating material engaging with the loops of the wire for the purpose of bringing the latter into contact with the track during the passage of the car.

Car Starter, W. Weaver, Westport, 488,462. Filed Oct. 28, 1891.

Employs a rotary motor upon each car, all connected to receive current from the same source, and means upon the locomotive for controlling the current.

Telephones and Apparatus :—

Telephone, P. Rabbidge, Sydney, New South Wales, 486,367. Filed Mar. 3, 1892.

A system of telephony designed for short distances and especially applicable for use in large buildings.

Guard for Telephones, E. B. Chase, Philadelphia. Pa, 488,385. Filed July 30, 1892.

Telephone System, C. C. Jennings, Chicago, Ill., 488,502. Filed Oct. 23, 1888.

Claim 1 follows :

In a telephone system the combination with a series of stations connected with each other by a series of broken double circuits, each of which is closed through one of the two stations connected thereby, a battery and fixed telephone at each of said stations, and electromagnet bells included in the telephone loop circuit of a portable telephone unaccompanied by a battery, adapted and arranged to close any one of said broken circuits at any point intermediate to said stations.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

MR. FREMONT WILSON.

We would invite the attention of electric lighting companies, contractors, architects and others, who are constantly in need of the services of an expert on interior electric lighting and fire insurance matters to the card elsewhere in this issue of Mr. Fremont Wilson, who is already well known in electric lighting circles, and who has in the past four years acquired an enviable reputation as an electric light insurance inspector. He has the confidence of the New York Board of Fire Underwriters, and is also engaged as special inspector for several of the largest companies in this country. He has lately severed all connection with electric lighting companies, and now acts entirely in the capacity of consulting expert to those desiring practical and accurate information on interior work, which he guarantees to pass the inspection of the Underwriters.

He was at one time connected with the Western Union Telegraph Company, but left his position there and worked under Mr. J. H. Vail, chief engineer of the Edison Company, for five years. He was also at one time the sole assistant and right hand man of Mr. F. J. Sprague; and it was under Mr. Wilson's supervision that the original steam and electric plant was installed in this city for the Julien Traction Company. Upon leaving the Julien Company Mr. Wilson became a contractor for interior electric lighting in this city, but determined to give up this branch of the business and enter a field then entirely new in this city, namely that of an insurance expert for electric lighting companies. Mr. Wilson was fortunate enough to be recommended to the local Westinghouse interests in this city as a man of high standing, and became associated with them. He at once commenced an aggressive campaign against poor interior wiring. He is a firm believer of special methods for interior wiring which have been discussed in this journal before, and which are now being adopted in the installing of interior incandescent wires at the World's Fair. During the past three years he has devoted the greater portion of his time to alternating current installations in this city, and the finest, most complete, and safest theatre installations in this country have been installed under his supervision.

His reports on insurance matters are accepted as correct by the leading Boards of Underwriters, and he is authorized to make surveys subject to their authority throughout the entire country. At the time the Subway Commission in this city was first formed, Mr. Wilson was tendered the position of electrician for the Board of Control, but declined its acceptance. A year ago his name was mentioned in connection with a position as chief electrician for the National Board of Fire Underwriters by some of the leading insurance people of this city.

THE WURTS NON-ARCING LIGHTNING ARRESTER.

Elswhere in this issue will be found a most interesting account by Mr. Alex. J. Wurts, on the remarkable action of his non-arcing lightning arrester. In regard to the practical application of this metal to the construction of a non-arcing lightning arrester much can be said in a very few words, and in the simple announcement that out of more than 2,000 non-arcing metal arresters which have been in actual service during the past season on 1,000, 2,000 and 3,000 volt alternating current circuits, not one of them has failed. Such a record as this is truly phenomenal.

To those particularly interested in this subject, the following letters addressed to the Westinghouse Company will probably be more interesting, or at least carry more weight than the mere description of laboratory tests; and Mr. Wagner's letter is worth more than a passing glance in that it illustrates well the satisfactory results obtained by a liberal use of line arresters.

Mr. R. A. Snyder, electrician of the Saratoga Gas and Electric Light Company, of Saratoga, N. Y., writes :—

Gentlemen :—In regard to lightning arresters the "Wurts Arrester" is the best that I have ever seen. My experience with it has been all that could be desired. Since having them on our switchboard we have had three of the most severe thunder showers that I have ever seen and we got our share of the lightning, but the Wurts non-arcing lightning arrester took care of its part of the work to such an extent that it carried 12 or 15 discharges to ground during each shower with scarcely a vibration on the instruments or a strain on the belts, also without blacking arrester to speak of, while an arrester of another make burned out and held arc to ground until we could shut the circuit down.

After my experiences with the Wurts non-arcing arrester, I shall never be satisfied with any other.

Mr. W. H. Blood, Jr., of the Franklin Electric Company, of Kansas City, writes as follows :—

Gentlemen :—Answering your favor of Nov. 2 in regard to our experience with the non-arcing metal lightning arrester would say that we have used several, the worst case being where they were on a 2,000-volt circuit which is connected with a compound machine and although they have passed through many severe lightning storms they were always able to carry off the discharges. They went through some of the severest storms that have ever occurred in this part of the country and many dynamos in the neighborhood were burned out, while those protected by these arresters were unaffected. We do not see how anything could work better than these.

Mr. Herbert A. Wagner, superintendent of the Missouri Electric Light and Power Co., of St. Louis, writes as follows:—

Gentlemen :—I do not wonder that you have difficulty in persuading customers of the practicability of your non-arcing lightning arresters, as at first sight it seems incredible that such a device could work. We have, however, had about 200 of them on our lines for several months, and during all the severe lightning storms of the past spring and summer, we experienced no trouble of any kind on our lines or in our station We have never had a short circuit on our lines during a storm, which would indicate that the arresters promptly broke the arcs as soon as they were formed; neither have we had any arresters burned out or in any way disabled. From my experience with these arresters, I consider them superior to any device which has ever been made before for the purpose, and more simple and effective than I ever imagined a lightning arrester could ever be made. How to prevent the occasional destruction of our converters and switchboard devices by the severe lightning storms which we frequently have here, has been a very great problem for the last two years. From our experience during the past summer, I now think we have the problem solved by the use of a large number of your non-arcing lightning arresters placed at frequent intervals along the lines. We also have a lightning arrester on each circuit where it enters the building, but these are very rarely called into service, as those on the line seem to be sufficient to take care of all discharges. I would be most pleased to recommend your arresters very highly to any one you may refer to me.

F. A. Cheney, general manager of The Elmira Illuminating Company, Elmira, N. Y., writes :—

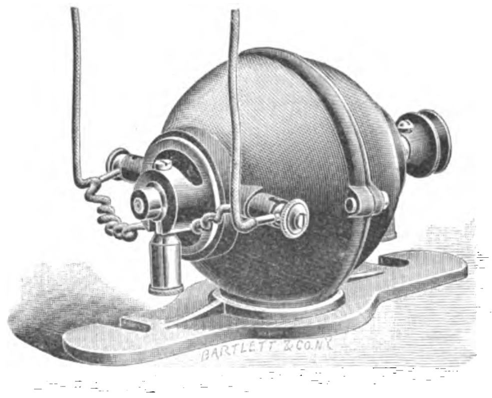
Gentlemen :—In reply to your letter of Nov. 10, regarding lightning arresters, we would say that we have two of the non-arcing arresters in use, and during the past summer these arresters were in operation during six severe thunder showers. Upon one occasion, the lines were struck in three different places ; but notwithstanding this, the arresters took care of the current without the machine tenders knowing anything about it. We found, upon examination, where the current had crossed from bar to bar, leaving scarcely a perceptible mark. We have known positively of nine discharges passing through one of them. To all appearances they are in just the same condition as when erected.

Mr. W. Hoopes, superintendent of the Bala & Merion Electric Company, Cynwyd, Pa., writes :—

Gentlemen :—Your favor of the 11th inst., is at hand, and we would say that we have been using the non-arcing type lightning arrester for several months and consider it successful. Previous to its adoption, we lost one or more transformers during every electrical storm, but since we have distributed the non-arcing arresters liberally over our line, we have not lost a single transformer. We have had some very heavy electrical storms during the past season, and on three occasions, trees have been shattered within a short distance of our lines; each of these occasions was accompanied by a heavy discharge across our station arresters, but no damage was done, so that we have both practical and visual evidence of the value of this sort of protection.

NEW LUNDELL BATTERY MOTOR.

In response to a demand for a small slow speed motor which is adapted for sewing machines and light work of that character, the Interior Conduit & Insulation Company have brought out a small Lundell motor which we illustrate herewith.


BARTLETT & CO. N.Y.

New Lundell Battery Motor.

These motors are wound for both 110 and 4 volt battery circuits and their extremely slow speed,—1,200 revolutions per minute,—their efficiency and torque is said to be remarkable for motors of their size and capacity. They are mounted firmly on a base that may be secured to the floor or any substantial support, and the screw slots in the base provide a ready means for quickly tightening the belt. These motors run absolutely noiseless, are fitted with self-oiling and self-aligning bearings and are neatly finished in black japanning with red and gold striping.

These new motors complete the list of Lundell motors recently placed upon the market by the Interior Conduit & Insulation Company, from $\frac{1}{16}$ to 5 h. p. capacity. The above small motors are used exclusively by the Automaton Piano Company, for operating the mechanism of their automatic piano.

The electrical engineer of a western construction company in sending us some information writes: "You will find my name on your books, and I don't think it will be taken off as long as the money gives me such fine returns. I would not be without your paper on my desk."

A NEW GENERAL ELECTRIC SWITCHBOARD.

ONE of the handsomest and largest switchboards in the world, has just been completed at the Schenectady Works of the General Electric Company for the first station of the Edison Electric Light and Power Company of San Francisco, and is shown in Fig. 1 of the accompanying illustration. It is constructed of slabs of highly polished white Italian marble mounted on an iron frame, and is 56 feet 8 inches in length. The board provides for the distribution of 2,200 kilowatts, or 14,666 amperes at 150 volts, from twelve generators of the General Electric Company's multipolar type coupled directly to triple expansion engines. Ten of these dynamos are of 200 kilowatt; two are of 100 kilowatt capacity, and all are arranged on the three wire system. The main and auxiliary busbars run the entire length of the switchboard and are set in a rack in the rear. They are so arranged that they can be cut in two at the centre by means of heavy switches on the face of the board. This allows the operation of the station under four different potentials at the same time. Provision is made for twenty-four feeders, each equipped with two ampere meters and three switches. Each switch has two blades, one for the main and one for the auxiliary bus, the positive and negative switches of each set being provided with safety catches.

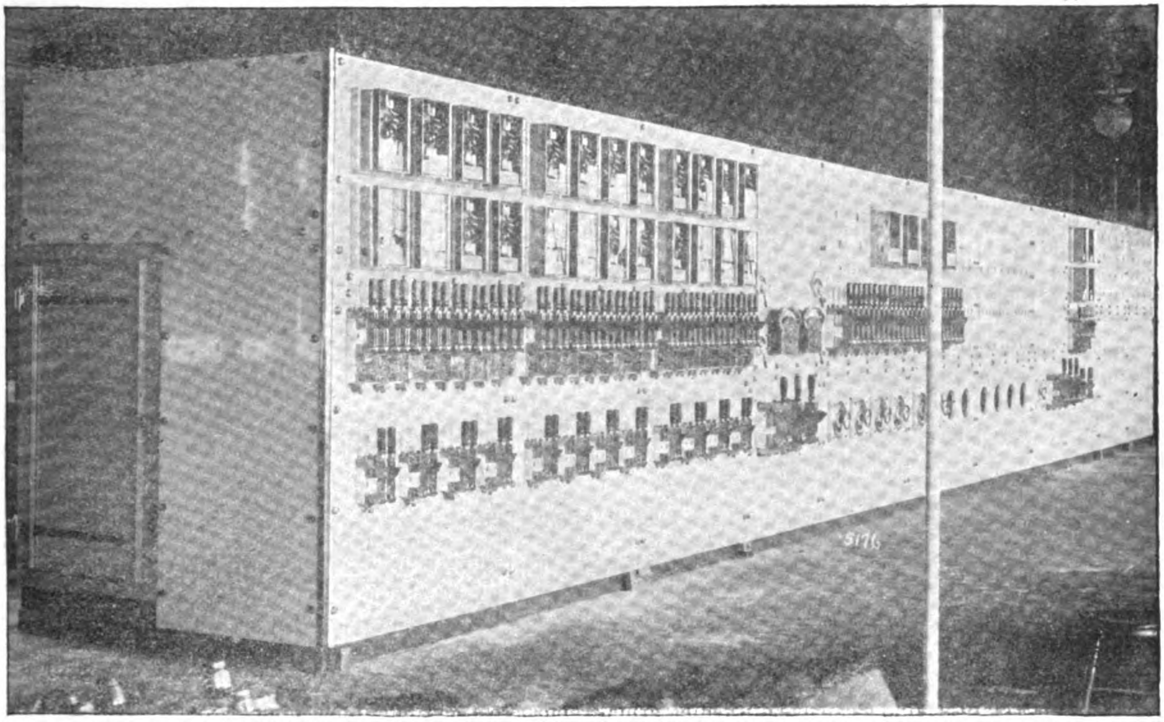


FIG. 1.—SWITCHBOARD FOR THE EDISON ELECTRIC LIGHT AND POWER CO., SAN FRANCISCO, CAL.

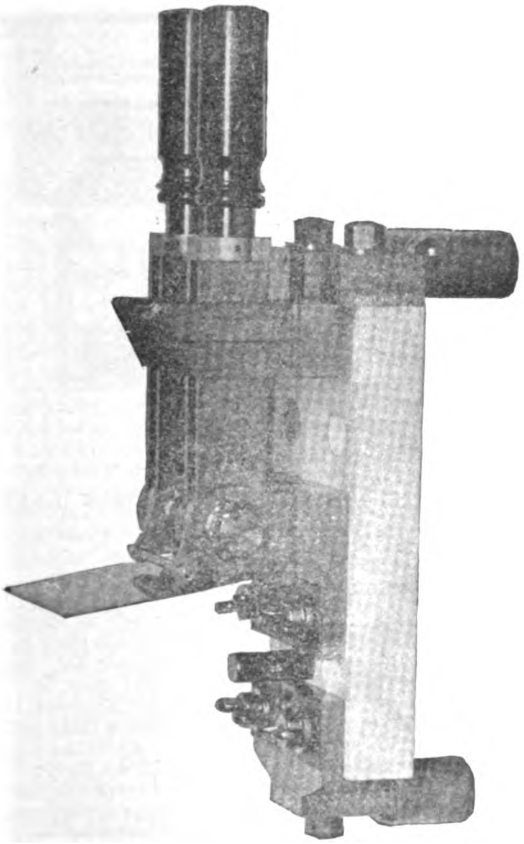


FIG. 2.—IMPROVED STATION SWITCH.

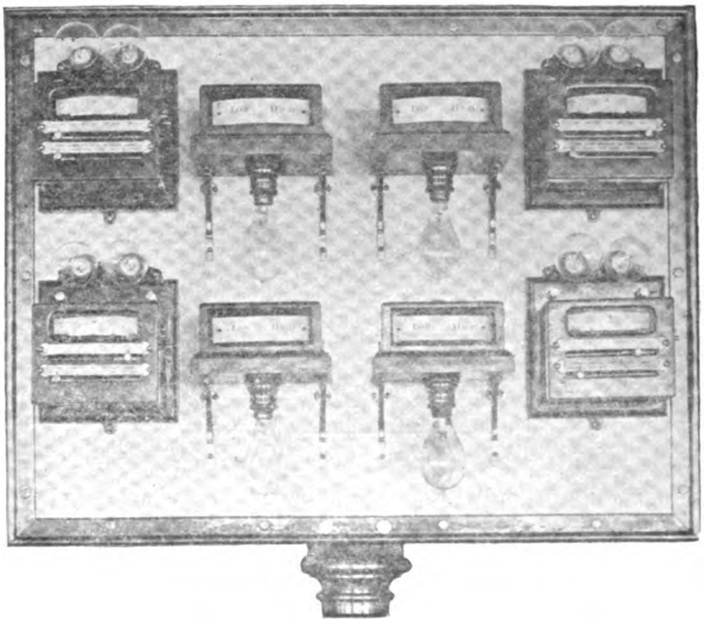


FIG. 3.—PRESSURE INDICATORS AND GALVANOMETER.

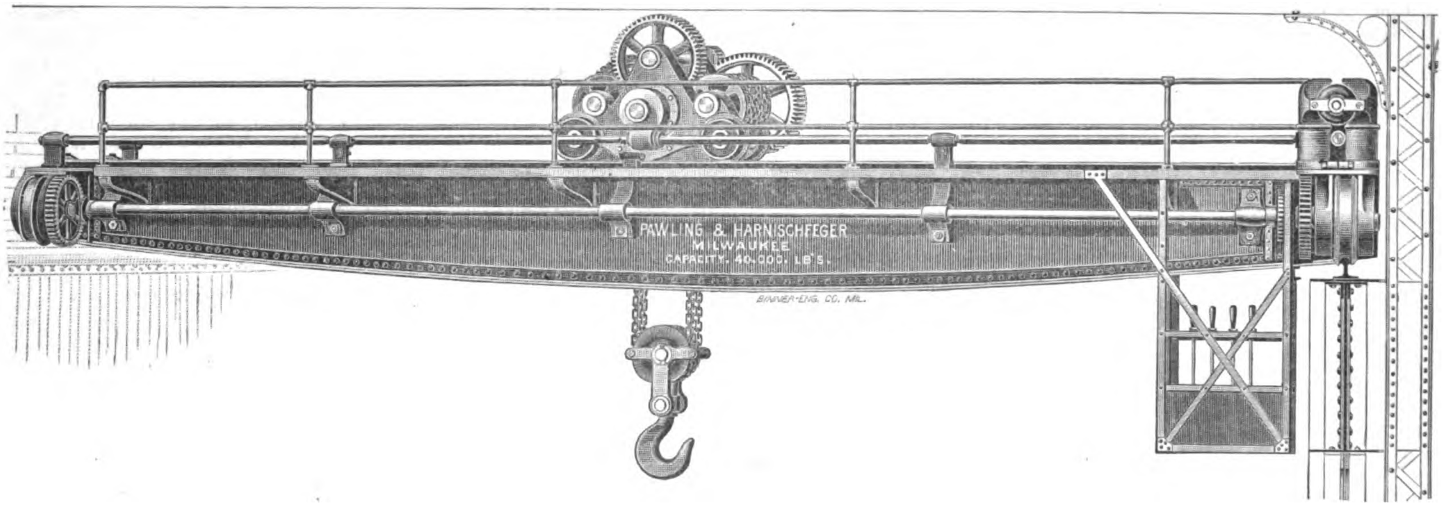
A novel feature in these last named switches, Fig. 2, is the mica covering for the fuse, which is hinged and can thus be readily raised where necessary for the insertion or adjustment of the fuse. A special thirty-point indicator switch is mounted on the board by means of which it is possible to read in the station the voltage at all the feeding points in the outside system. Each dynamo is provided with an ampere meter, a dynamo field regulator and two switches, each double-bladed, so that the dynamo may be thrown upon either the main or auxiliary bus bar. The ampere motors are mounted on bases of marble similar to that of the board, and have highly finished brass covers with fronts of bevelled heavy plate glass. The regulators are also fitted with white marble tops. Beside the apparatus already mentioned, the board is equipped with the necessary pressure and galvanometer switches. Two ornamental pillars supporting small auxiliary boards, are to be erected at either end of the board. Upon these will be placed the dynamo galvanometers and pressure indicators, Fig. 3. All connections are ma de at the back of the switchboard. Those between the instruments and the bus bars are through flexible copper cable of 1,500,000 circ. mills cross section.

The board is built up of 26 marble slabs, each of about 25 square feet of surface, and weighing in the aggregate over seven and a half tons. The weight of the main switchboard complete and fitted for the present requirements of the station, is 37,000 lbs. 5,000 lbs. of copper connecting cables, 6,000 lbs. of copper bus bar, and 10,000 lbs. of high conductivity metal were used in its construction. Each dynamo switch of 1,500 ampere capacity weighs 150 lbs., each double-blade feeder switch 100 lbs., and the large bus bar switch 200 lbs.

Fig. 1 shows the switchboard as it stood in the factory a short time before completion. When erected in its place in the station at San Francisco, it will be further adorned by the addition of an ornamental cornice and base board.

THE PAWLING & HARNISCHFEGER ELECTRIC CRANES.

Messrs. Pawling & Harnischfeger, of Milwaukee, Wis., who make a specialty of heavy machine tools, are now constructing for the Siemens & Halske Electric Co. of America, three large lathes which will be placed in the large works now being erected in Chicago. One of these lathes will be capable of turning armatures sixteen feet in diameter, and the other two will have ten foot swing.


PAWLING & HARNISCHFEGER
MILWAUKEE
CAPACITY. 40,000. LB'S.
BINNER-ENG. CO. MIL.

Electric Crane, Siemens & Halske Shops, Chicago.

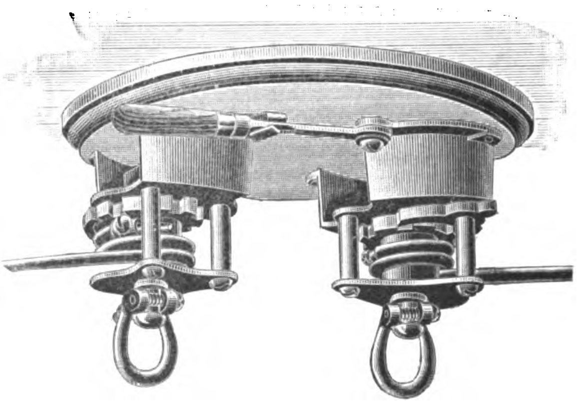
This firm also build electric cranes adapted for foundry use, traveling cranes, one type of which, designed to lift 20 tons, is shown in the accompanying engraving.

Messrs. Pawling & Harnischfeger have now under way a 15-ton electric crane for the Weisel & Vilter Manufacturing Co., and a 6-ton crane for Greenslade Bros., of Milwaukee.

PFLUGER'S LINEMAN'S DELIGHT.

In lining up a building for an arc circuit, the wire should be taut, straight and without sag. To accomplish this, insulators must be screwed to the ceiling at different intervals between ceiling boards, to keep the wire from sagging. These insulators not only disfigure and ruin the ceiling, but are in many instances the cause for grounds in the circuit.

To obtain a perfectly straight and taut line wire, the lineman has considerable trouble and has to use different tools such as come-alongs, tackles, pulleys, etc. The proper results can be obtained more cheaply and readily by using the ceiling board called "The Lineman's Delight." A glance will show the working of it. Place the ceiling boards in their proper positions, where lamps are required and cut off pieces of wire reaching from one ceiling board to the following one, being careful not to cut them off too short. Then fasten both ends of the wire in the revolving binding posts of the two different ceiling boards and wind those binding posts up with a wrench till the wire is straight and taut. The dogs engaging the ratchet will prevent the unwinding of the wire.



Pfluger's "Lineman's Delight."

The lamps are hung in the usual way to the ceiling board. Each ceiling board is provided with a switch to take the lamps out of the circuit when it becomes necessary. The advantages of the ceiling board are very easily seen; first, in obtaining a perfectly straight and taut circuit without any insulators; second, in saving a great deal of time in the construction, and therefore considerable expense; third, all kinds of wire, no matter how crooked, can be used; fourth, the wire can be removed instantly for the purpose of cleaning the ceiling, without any damage to the wire and board; fifth, any person can handle it. The ceiling board is secured by letters patent. It was invented and is manufactured by Chas. A. Pfluger, 313–317 S. Canal St. and 1762 N. Halsted St., Chicago, Ill.

RIES ISOLATED PLANTS.

The Ries Electric Specialty Company are at present installing quite a number of isolated plants, in which they employ a low tension alternating current dynamo, feeding the lamps directly without the use of converters. This plan they find highly satisfactory, as the converter losses are entirely avoided and the system permits the use of their regulating socket, thus affording the consumer the advantages of a safe and controllable light. In stations where converters must be used, Mr. Ries believes it would be far better to use a small number of large converters, each capable of feeding a number of houses from a common secondary circuit, than to use a large number of small converter units, as is now the general practice. Of course such large units could only be advantageously used where the houses requiring the light are situated closely together. The Ries Electric Specialty Company, have never found any trouble, however, where the isolated plants referred to have been installed.

MR. H. T. PORTER.

AN annoying mistake was made in the advertising columns of THE ELECTRICAL ENGINEER of December 28. Instructions were received from the Buckeye Engine Company to insert the name of H. T. Porter as the New York representative of that Company. This insertion, however, was made in the advertisement immediately under that of the Buckeye Engine Company—the card of the John T. Noye Manufacturing Company, which made it appear that Mr. Porter was to take charge of the New York office of the Noye Company, Mr. Copeland's address being omitted. The mistake was purely a mechanical one, and the many friends of Mr. C. H. W. Copeland will be glad to learn that he still continues in charge of the New York office of the John T. Noye Manufacturing Company at his old stand, 186 Liberty street.

TAKING A WHOLE BUILDING NOW.

F. P. LITTLE & Co , of Buffalo, will shortly remove from 141 to 135 East Seneca street, where they will occupy the whole building. The growth of their business is so large and steady as to require the additional facilities at once.

NEW ENGLAND NOTES

CUMNER, CRAIG & COMPANY, of Boston, is the name of a new firm recently started in the general electrical engineering and supply business, with headquarters at No. 509 John Hancock Building, Boston. Mr. Arthur B. Cumner has been for the past year connected with the Holtzer-Cabot Electric Company, and is a student of the Institute of Technology. He has a wide acquaintance among influential men in the city of Boston. Mr. J. Hally Craig has had years of experience in the electrical business both in this country and in England, and has been for the past two years connected with the Holtzer-Cabot Electric Company in various capacities. Mr. Craig is well known to electrical men in New England and elsewhere, and the new firm will doubtless soon become prominent in this vicinity.

THE BROWN ELECTRIC COMPANY, of Boston, has completed its organization, and will be all ready to commence business in its new and well appointed store on the corner of Summer and Federal streets. Mr. Maybin W. Brown, who is already well known to the electrical trade, will take the general managership of the company, and his numerous friends will be pleased to see him once more at the head of a good company. The Brown Electric Company will handle a general line of electric light, railway and power supplies, and will have exclusive territorial agencies of many well known and popular electrical goods. The location of the store is a good one, and the company are looking forward to a good business on the start of the New Year.

THE DAVIS ELECTRICAL WORKS, of Springfield, besides doing a successful business in the manufacture of incandescent lamps, have already achieved a marked degree of success in their comparatively new field of repairing burned out incandescent lamps. This company have a splendidly equipped factory in Springfield, thoroughly adapted for the work. They will take burned out lamps, open the bulbs, put in new filaments, seal them up and return them to the consumer in as good a condition as, if not better than, when new. Every consumer of incandescent lights should investigate this plan of repairs, as it is claimed that considerable saving can be made.

THE MASSACHUSETTS CHEMICAL COMPANY are in receipt of many of the strongest kind of testimonials in favor of their Insullac for armature and other electrical insulation. It seems to have filled a felt want, and as it can be used on armatures without baking, it saves a large amount of time, labor and expense. One of their most recent testimonials from the West End Street Railway Company, of Boston, who are using it exclusively for their motor armatures, is well worth reading, and will be found printed in full on page 15 of the advertising matter in this issue.

THE BOSTON ELECTRIC LIGHT COMPANY, have completed their plans for a new station in South Boston. The station will have a capacity at present for 1,000 h. p., though the general plan allows for an increase up to 2,000 h. p. The station is being built primarily for the accomodation of South Boston, though circuits will be run to Matapan and Roxbury districts, and will include arc, incandescent and power apparatus. All modern improvements will be adopted, such as mechanical stokers, coal conveying apparatus, slate switchboards, traveling cranes: and everything done to make this a model station in every respect.

MR. H. H. BROOKS, of the American Circular Loom Company has just returned from a two months trip to the Pacific coast in the interests of his company. The outlook for a large business in their specialties of wire and conduit is extremely good, and Mr. Brooks is already devoting his attention to the increase of their facilities for manufacture.

MR. C. O. BAKER, of Newark, was in Boston last week, presumably to sell platinum. Report has it, however, that he was seen, in company with a number of other well-known electrical gentlemen, in the vicinity of the Sheriff's office, and afterwards capably filling the position of an expert appraiser of certain electrical goods. Mr. Baker has reason to be proud of himself in his new rôle of electrical expert and appraiser. It is really a pity that he has such large interests in the platinum industry.

THE GIANT ELECTRIC MOTOR COMPANY, of Portland, Me., have recently closed a contract with the Manchester House, of Manchester, N. H., for an isolated electric lighting plant, and also recently closed a contract with the town of Phillips, Me., for the town electric lighting plant. The Giant Company have several other plants under consideration, and are at present making arrangements for doing the heaviest kind of electrical work, and in largely increasing their manufacturing facilities.

L. DION, of Natick, Mass., has disposed of his invention of a closed conduit system for propelling electric street cars, to a Boston syndicate, of which Mr. Oliver Ames, of Boston, is president, and Col. Levi R. Greene is general manager. The drawings for a working model are being pushed to completion, and it is proposed to demonstrate the value of the invention on a short section of track, as soon as the model is built and arrangements can be made.

THE CAMPBELL ELECTRICAL SUPPLY COMPANY, of Boston, are following up their previous announcement of the manufacture of "Century" wires and cables, with a neat price list, which gives details of their various manufactures in wires, cables, tapes, insulating paints, and belt dressing. They also call attention to their anti-induction telephone wire, and to the "National Shielded" wire, which is made for places where excessive abrasion is met with.

MR. HENRY F. KELLOGG has been appointed manager of the new municipal electric light plant for the town of Wellesley, Mass., which has recently been put in operation. Mr. Kellogg will still retain, however, his business connection with the Whitney Electrical Instrument Company, of Boston.

PETTINGELL, ANDREWS & CO., 190-202 Summer street, Boston, have issued a very neat calendar for 1893, with an engraved study after Rosa Bonheur at the top. It is intended to advertise their electric railway and electric light supplies, and will accomplish its purpose very effectually.

THE WALWORTH MANUFACTURING COMPANY, of Boston, are in receipt of orders from the Thomson-Houston International Company for two car loads of their well known street railway poles for Rio Janiero, one car load for Mexico, and one car load for the West Indies.

PHILADELPHIA NOTES.

THE PENNSYLVANIA ELECTRIC ENGINEERING COMPANY has contracted to place in the Commonwealth Hotel, Harrisburg, two multipolar National incandescent dynamos, one of 700 the other of 350 lights. They are also placing 55 1,200 c. p. arc lamps, one National dynamo and five miles of construction work for the Steelton Light & Power Company, Steelton, Pa.

THE PARTRICK & CARTER COMPANY will soon bring out a simplified "Return Call and Fire Alarm System" which will be low in cost and thoroughly efficient in its workings. They will also begin the delivery of their new automatic annunciator early in January. Orders are already booked for them far in excess of their anticipation.

MR. T. L. TOWNSEND, of the Partrick & Carter Company, has just returned from a three months' trip through the South. He is a quiet young man but his order books are eloquence itself.

WESTERN NOTES.

THE RACINE HARDWARE MFG. CO., of Racine, Wis., have been awarded the contract for building twenty-five electric launches for the World's Columbian Exposition. These boats are 34 feet long by 6 feet beam and are to be fitted up in the latest improved manner, with decking and interior finish of mahogany, canopy top and all modern appliances. These boats are for use on the lagoons, to carry the World's Fair visitors, and are to be completed by May next.

THE LUNKENHEIMER Co , of Cincinnati, have doubled their capital to $500,000, so as to meet the demand for the celebrated Lunkenheimer brass and iron specialties. The business will now be carried on under the above name, with E. H. Lunkenheimer, as president; C. F. Lunkenheimer, as vice president, and D. T. Williams as secretary

WESTERN NOTES.

Mr. Leslie W. Collins, who for some time past has been the New York representative of **The Electrical Engineer**, has been transferred to Chicago, where he has already assumed the duties of Western Editor and Manager, with large and commodious offices in the Rookery. Mr. Collins is so well known and popular in the West that he needs no introduction.

World's Fair Notes.—The mechanical and electrical engineering section of the construction department, which is in charge of Mr. Frederick Sargent, have removed from their old quarters in the Construction Building in the Fair grounds at Jackson Park to a new building built especially for them in the rear of Machinery Hall, where they will remain during the entire period of the Exposition. The new offices are very handsomely and conveniently fitted up, private rooms being prepared for each of the staff. The incandescent lighting in this building is being furnished from one of the old-time Edison dynamos of the "L" type, which is quite a curiosity in its way but does excellent work. This, together with a 50 light Standard dynamo built by the Standard Electric Co., of Chicago, forms a small additional temporary plant which is located in the Machinery Hall annex, these two machines being driven by a Ball & Wood engine. As soon as the Westinghouse Co. are ready to furnish current, they will take over the incandescent lighting in this building.

The New York Insulated Wire Co. are making good progress with the wiring of the World's Fair buildings. All the State buildings and the Administration Building are practically completed and work has now been commenced on the Women's Building. The work in the Administration Building is being pushed with the utmost despatch in order to enable the offices of the Director-General and heads of departments now in the Rand-Mc Nally Building to be moved there, where they will go immediately the Westinghouse Co. have their lights running there for them. They will probably move in about this time. This will bring all the departments of the Exposition on the grounds at Jackson Park in the most favorable position for rapidly completing the work at the Fair. The Worthington Co. are busy on the immense pump station which they are building in the grounds.

The Railway Equipment Company are handling a voluminous business in the Ahearn electric heating devices for the manufacture of which they some time ago equipped a very complete factory. The orders have come in so rapidly from all parts of the country that they have had hard work to keep up with them, but with increased facilities hope to be able to do so very shortly. Mr. W. R. Mason, the president of the company, reports great activity in the electric railway supplies manufactured and handled by his company. The new line of overhead devices recently placed on the market are having a very large sale.

Taylor, Goodhue & Ames, Monadnock Building, Chicago, are doing a brisk trade and getting hold of an exceedingly fine line of new and valuable specialties. The "Diamond" converter, the agency for which they recently secured is proving a rapid seller and its good features are being duly appreciated. The Standard Electric Company are very busy turning out their arc machines and lamps, they have recently secured several large contracts for their deservedly popular system.

Mr. Albert Blanchard, 427 Rookery, Chicago, has furnished quite a number of power plants with the complete combustion down-draft boilers for which he is agent in the west. Mr. Blanchard states that they are a positive panacea. He contracts to build complete power plants for electric lighting, railway or other work and his extended experience in this line insures the erection of an economical and reliable plant.

The Electric Appliance Company report large sales of their new Acme wire guards. They are placing large numbers of them with eastern and western jobbers as well as supplying them to large users all over the country. They report that the new Whitney instruments for alternating currents will be ready for the market very shortly as well as a line of cheap switchboard instruments.

The Mosher Electric Company, 137 Ontario street, Chicago, have received a large number of orders for their arc lamps for direct and alternating incandescent circuits. They are turning them out as rapidly as possible and have increased their facilities considerably to take care of the growing business. They state that their lamps are giving excellent satisfaction and that users are well pleased with them.

The Enterprise Electric Company are now settled in their new quarters, 307 Dearborn street, and are ready to take care of any amount of business with their increased floor space and facilities. All lines of trade are good, especially in National India Rubber wire. They expect to put in the market some new and meritorious specialties the first of the year.

Mr. Leo Daft, who is so widely known as one of the early pioneers in electrical engineering, he being one of the first to advocate and introduce electrical transmission of power in this country, spent several days in Chicago last week, buying machinery. Mr. Daft then went east where he will visit the principal large cities.

The Post-Boynton Strong Company, 413 Home Insurance Building, make a specialty of the manufacture of battery zincs. They are casting a large amount of metal for this purpose right along, and they guarantee their zinc to be of the highest obtainable purity.

Wm. Hood & Co., managers of the Chicago office of the Electric Manufacturing Co., Oconto, Wis., are filling orders for Brilliant lamps which continue to flow in upon them. They make many strong claims for their lamps and their factory is kept busy.

Mr. A. M. Walter, who has a large acquaintance in electrical circles in Chicago and the west is spending a short vacation here. Mr. Walter is now connected with the General Electric Company in their factory at Lynn.

Mr. F. Bathurst, of the Schenectady Works of the General Electric Company, was among the visitors to the World's Fair city last week.

NEW YORK NOTES.

Goubert Feed Water Heaters. Among recent sales of the Goubert Manufacturing Company, 32 Cortlandt street, New York, —sole makers of the Goubert feed water heater—we notice the following: Negaunee and Ishpeming Street Railway and Electric Company, Negaunee, Mich., 350 h. p.; Urbana and Champaign Electric and Street Railway Company, Champaign, Ill.. 600 h. p.; Mutual Light and Power Company, Montgomery, Ala., 700 h. p., Edison Electric Illuminating Company, of New York, 2,000 h. p.; Edison Electric Illuminating Company, of Brooklyn, N. Y., 1,000 h. p.; West Side Street Railroad Company, Elmira, N. Y., 400 h. p.

Mr. J. Stanford Brown, E.E., has resigned his position as resident engineer of the Camden Horse Railroad Company, Camden, N. J., to take effect at the end of December. This move will not sever his present cordial relations with the company as he is retained by them as consulting and supervising engineer. With the new year Mr. Brown becomes consulting and constructing engineer to the Neftel & Marsh Company of 136 Liberty St., New York, and will thereafter again make his home in this city.

Mr. William Wright has resigned from the Wright Universal Electric Company, of 26 Whitehall street, this city.

CANADIAN NOTES.

Mr. Charles F. Medbury, formerly with the Thomson-Houston Company, Boston, Mass., has been appointed agent of the Canadian General Electric Company for the Montreal district.

The Royal Electric Company of Montreal has been awarded by the Montreal City Council the contract for lighting that city for a period of ten years from the expiration on January 1st, 1894, of the present contract of this company with the city, at the following yearly rates:

1st. term of	5 years.....	$124.10 per light.....	.34 cents per night
2d. "	" 3 "	120 45 " "	.33 " " "
3d. "	" 2 " ...	116.80 " "	.32 " " "

There are 2,000 c. p. arc lights burning all night, for which the price by the unexpired contract is $146. There are now in use for lighting the city 915 arc lights and 360 incandescent lights of 32 c. p. each, besides some 700 gas lights.

The Automatic Telephone and Electric Company, of Canada, has been organized with a capital of $250,000, and has purchased the Canadian patents of Mr. A. B. Strowger for his automatic telephone exchange system, which dispenses with the central operator. The object of the company, whose head office is at Montreal, is to introduce this system throughout Canada, and also to manufacture the apparatus as well as fit up and equip telephone exchanges. At a recent meeting, Mr. J. P. Dawes was elected president, Mr. H. M. Linnell, formerly with the Edison Company, managing director, and Mr. J. A. Culverwell, general agent.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XV. JANUARY 11, 1893. No. 245.

LAMINATED OR DIVIDED IRON AND OTHER METALLIC MASSES IN ELECTROMAGNETIC APPARATUS.—II.

BY

Thos. D. Lockwood

Charles Grafton Page.
(From *Scribner's Magazine.*)

THE three names most prominent in connection with the earliest instances of adoption of divided iron cores are those of Sturgeon, Bachhoffner and Page. So far as I can ascertain, William Sturgeon was the first to publish an account of the benefits to be derived from dividing the iron of an induction coil core. His announcement was made in a paper read before the Electrical Society of London, August 5, 1837, which paper is published in *Sturgeon's Annals*, (Vol. i. pp. 470–484.)

In Sturgeon's experiments, he made an electromagnet with a core formed first, of a cylindrical roll of sheet tin; and second, of a bundle of iron wires. In this connection he remarks that a Mr. Payne had tried the magnetic effects of a bundle of iron wire in an electromagnetic helix. This, it is evident, concerns merely the core of an electromagnet, and the effect upon its attractive power of dividing the same.

These experiments, however, led Sturgeon, as recorded in the same paper, to try divided cores in his induction coil, and he goes on to tell us how first he tried a solid iron core with advantage, but that he found the advantage to disappear as he increased the speed of his circuit breaker, and that he then successively tried iron tubes, cylindrical rolls of sheet tin, a bundle of thin iron wires, and bundles of narrow strips of tin plates (true laminations); with the result that the sparks were much brighter and the shocks much greater; and this with a much higher speed of the circuit breaker. He then discusses the philosophy of these phenomena, and ascribes them to magnetic inertia.

Sturgeon adds a footnote to this paper, to the effect that about a fortnight before the reading of the paper, he had lent Bachhoffner one of his coils, and that he, without knowing anything of Sturgeon's experiments, had independently discovered that a bundle of iron wires in the axis of the helix caused it to give a better shock than when a solid bar was employed; and on page 496 of the same volume is found a letter from Bachhoffner describing the mechanism he employed, and accentuating the statement that *the iron wires of his* core were insulated. We find (*Annals*, Vol. ii, p. 73) that the same gentleman read a paper before the Electrical Society of London, Oct. 23, 1837, which remarked that in a former paper he had stated that the insertion of a bundle of wires in the axis of the coil increased its power twofold; he would now say twenty fold.

In a letter dated Feb. 10, 1838, (*Sturgeon's Annals*, Vol. ii, p. 203), one J. C. Nesbit, describes an induction coil built upon the lines laid down by Sturgeon, and says that he has "a bundle of very thin iron wire in the axis of the bobbin."

Only a few days later, Prof. G. H. Bachhoffner, again has a paper, (*Annals*, Vol. ii, p. 207), written apparently in confutation of a paper read by Dr. Golding Bird, in which reference appears to have been made to the merits of a divided core, without giving credit to Bachhoffner for such a core. In this paper Bachhoffner substantially asserts himself to be the originator of the idea. He refers to a statement made by Golding Bird that the effects of induced currents were "considerably augmented when the bundle of insulated iron wires was employed in lieu of the bar of iron," and states (p. 213) that he (Bachhoffner) has "invariably employed the bundle of insulated iron wires." He also points out that to surround the wires by a scroll of tinned iron practically converts them into a bar, and is of no use.

These gentlemen all appear to have experimented first, and reasoned later. Professor Charles Grafton Page to whom we must now refer, seems to have reasoned the matter out first, and then to have proved the correctness of his reasonings by experimentation. He records his work in *Silliman's Journal* (Vol. xxxiv, No. 1, p. 167, July, 1838), and (Vol. xxxv, 1839), the latter paper being dated at Washington, Nov. 13, 1838.

In his "History of Induction," published in Washington, 1867, which I have closely examined, he refers to these papers, which also appear in abstract form in *Sturgeon's Annals*, (Vol. iii, pp. 389–393, and pp. 478–486). None reading these papers can fail to be impressed with the idea, that the part borne by Page in the investigations which produced the modern induction coil, was of the highest consequence. He calls his induction coil, a compound magnet. He tells us that he removed the bar of iron from the coil, and in its place introduced a bundle of annealed iron wire, which magnified the sparks and shocks surprisingly. He then successively substituted a bundle of smaller wires, and a bundle made of *seven pieces of hoop iron*, which latter he found to produce very powerful effects. In discussing these phenomena, he says; "When the battery is withdrawn, there is not magnetism enough retained to affect a very delicate needle. From this perfect neutralization of power arises in great measure the intensity of the secondary current. The neutrality is partly due to the reduced size of the bars, but chiefly to the action of their similar poles upon each other, when the exciting cause is withdrawn."

He notes in his second memoir that steel, when divided, answers very well for cores, and accounts for this also, by the above theory of polar re-action; and finally considers the action of closed circuits in the metal associated with coils, such as tubes between the two coils or between coils and cores, showing their dulling effect; and points out that in view of such action, metal bobbins, or bobbins having metal cheeks, should not be used. Much of Page's work is recounted by himself in his little book "The History of Induction," published in Washington in 1867.

Here, so far as divided cores are concerned, Page claims for himself independent invention, but nothing more; and states that the discovery with him "was the result of a process of inductive reasoning" as related by him in *Silliman's Journal* (Vol. xxxiv, No. 1, p. 167, for July, 1838). He also refers (p. 29) to the same article of Golding Bird, which excited the ire of Bachhoffner, as having appeared in the January number of the London and Edinburgh *Phil. Mag.* 1838, (Vol. xii, p. 18); and referring to the circuit breaker there described, mentions that Bird states in his article that he thought it was his own, but that on the arrival of the October number of *Silliman's Journal* for 1837, he had found himself anticipated and that the merit of "originality" belonged to Dr. Page.

Before dismissing Page, we must refer to the fact that he, being employed in the Patent Office, could not when he was ready so to do, take a patent for such features of the induction coil as he considered were justly his own invention; but that in 1868, by special act of Congress he was permitted to take out a patent, which was granted April 14, 1868, (No. 76654), and which was re-issued with additional claims, October 10, 1871 (No. 4588). This was the celebrated Page patent which was sustained by Judge Blatchford in 1879. In its specification, the iron core made of a bundle of plates or wires is shown and described, and its effect stated; Fig. 1 of this paper is a copy of the patent office drawing of this core, and shows four forms which we may call A, B, C and D.

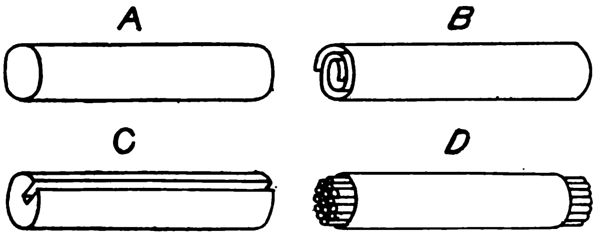


Fig. 1.

Prof. Page in his specification says the core "is composed of a bundle of soft iron wires, separated from the primary coil by a layer of some insulating material. If the wires are clean and bright, it is best to varnish them." He says further on: "Instead of a bundle of iron wires placed in the axis of the coil, the magnet may consist of thin plates, as shown in Fig. 1 A, and the plates may be made to adhere by varnish between them; or a piece of thin sheet iron rolled up into a scroll, as shown in Fig. 1 B, may be used, the surface of the iron being covered with varnish. Or a bar of iron divided by a longitudinal furrow or groove down to its axis as shown in Fig. 1 C may be used. The bundle of wires is, however, the preferable form, as shown in Fig. 1 D, the bundle or fasciculus, as it is sometimes called, being bound or wrapped with some non-conducting material."

I do not see that Page in his patent describes anything in advance of what he might justly found upon his early communications to *Silliman's Journal*, and it is most interesting to note that at this time he had fully recognized the identity in principle between cores made of wires, cores made of plates, and solid but grooved cores; and that he also had recognized the necessity of insulating the individual elements of a divided core from one another.

From a consideration of the record, it appears to me that Sturgeon was first in the idea of dividing the iron of cores, and first also in publication; that Bachhoffner was a close second, both in performance and publication, and also the first to observe the utility of insulating the wires; and that Page was third in performance and publication, second in noticing the importance of insulation, and an easy first in his reasonings upon the subject; and independent and original in every point.

In the Southern States during 1892, no fewer than 102 electric light companies were formed.

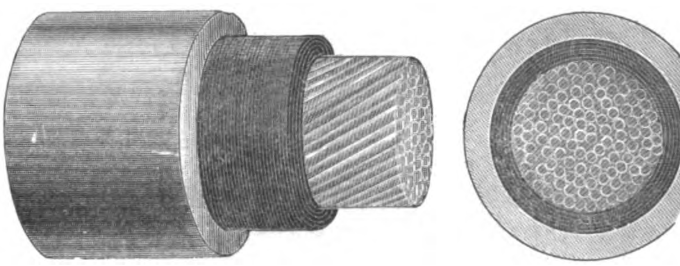
NEW YORK'S ELECTRICAL SUBWAYS.—II.

BY

Wm Maver Jr.

VII.—CABLES EMPLOYED IN THE SUBWAYS.

The cables employed by the Telephone company are chiefly of the lead encased fibrous type—namely the Paterson; also a paper cable.[1] The telegraph companies also use cables of the fibrous type, The Standard Underground, Paterson, etc., but they also employ many rubber compound cables, such as the Kerite, Okonite, Safety, etc.

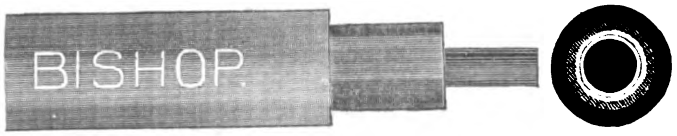


Eigs. 7 and 8.—Standard Underground Cable.

The cables used in the electric light service, exclusive of the "Edison," are of two general types, namely fibrous and rubber compounds; both of which are lead covered. Fibrous cables are, of course, lead encased to exclude moisture. Rubber cables were primarily lead encased to prevent the ill effects of gases, acids, etc., upon them. They would most likely now, if for no other reason, be lead encased to prevent the deterioration which it is well known occurs when vulcanized rubber is freely exposed.

The size of the electric light conductors employed in the subways varies with the requirements, from No. 000,000 to No. 10 B. & S. The thickness of the insulating wall of the cables varies with the type of cable employed and also with the electrical pressure which the insulation is expected to withstand, being as a rule somewhat thicker in the case of fibrous cables than in that of the rubber compound cables.

Of the fibrous cables in operation in the subways in the electric light service, by far the largest amount has been manufactured by The Standard Underground Cable Company,—approximately 290 miles. There are a few miles of a paper cable known as the Norwich, employed in this service. In this cable the paper is laid over the conductor in strips, spirally, to a thickness of about .175 inch; the paper having previously been saturated with a resinous solution.



Figs. 9 and 10.—Bishop White Core Cable.

Of the rubber compound cables in the electric light subways the bulk is manufactured by the Safety Insulated Wire and Cable Company, of whose product there are in use about 280 miles. This cable is known as a seamless cable, the rubber compound, while in a plastic state, being pressed on to the conductor while passing through a suitable die. The rubber compound is placed in a chamber which is kept, by suitable means, at a desired temperature. Mechanism within the chamber gives the plastic compound a tendency towards the die. The wire passes, from a reel, through the chamber, and in passing out is held accurately in the centre of the die, which insures an even distribution of the compound around the wire. The wire is then drawn slowly over a long table to a large reel, after which it is placed in the vulcanizing chamber.

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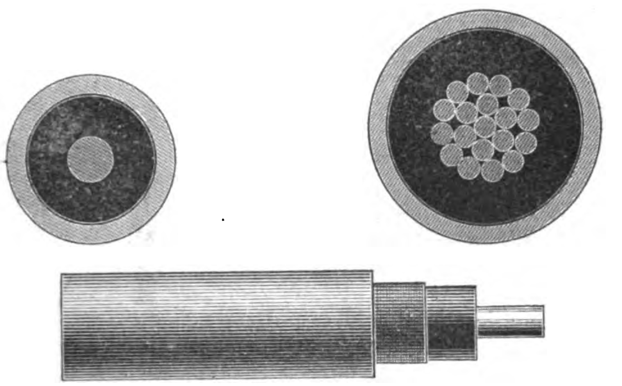
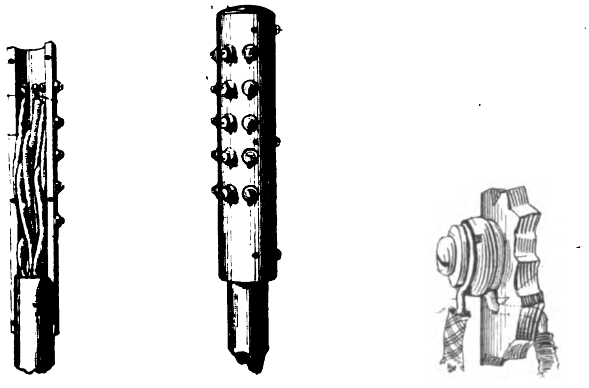
[1] See "Recent Improvements in Telephone Engineering, by H. L. Webb," in The Electrical Engineer, Sept. 7, 1892.



Figs. 11, 12 and 13.

There are also in use in the electric light subways about 25 miles of the well-known white core rubber cable manufactured by the Bishop Gutta Percha Company; also about 20 miles of Cobb cable and a few miles each of Okonite and Simplex rubber cable.

Several of the above mentioned cables are shown in section and cross-section in the accompanying figures. Figs. 7 and 8 represent an electric light cable (stranded conductor), cross-section and lengthwise, of the Standard Underground Cable Company's manufacture. The lead casing, the insulating material, and the conductor are clearly defined. Figs. 9 and 10 illustrate a section and cross-section of the Bishop white core cable, solid conductor. Figs. 10 and 11 represent cross-sections of the Safety seamless cable. Figs. 11 and 12 show the exact size of the conductor, (solid and stranded) and the thickness of the insulating wall and lead casing of a No. 2 B. & S. and No. 0000 B. & S. conductor, respectively. Fig. 13 represents a section of the same cable. In Figs. 11, 12, 13 also the tape which is wound over the insulation is indicated. This taping is found serviceable in protecting the rubber insulation from injury when the lead covering is being put on and when the latter is being removed in joint making.

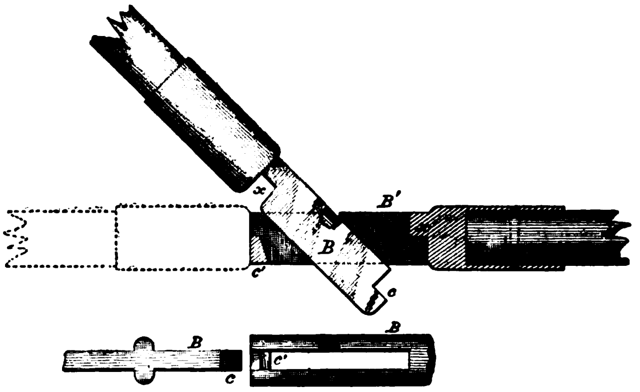


Figs. 14, 15 and 16.

It is known that fibrous cables depend upon their lead covering for the maintenance of insulation. Extra care is therefore essential that the terminals of such cables shall be well protected from moisture. Where these cables enter street lamps, vaults, etc., the ends are often covered with rubber strips to exclude moisture. In other cases a short piece of rubber insulated wire, carefully jointed to the fibrous cable, is used to continue the circuit to lamps. The Standard Underground Cable Company has recently introduced a simple device which has been found to give excellent results, while leaving the terminals of the cable quite accessible. It consists of a hard rubber tube separable into two parts, longitudinally, and having along one of its sides, apertures of a size suitable to receive any desired wire, Figs. 14 and 15. If the cable has several conductors the terminal of each is put through one of those holes and is then made fast to a binding post on the outside of the tube, Fig. 16. The other half of the tube is placed in position and the tube is then filled with an insulating compound impervious to moisture. The terminals of the conductors may then be freely exposed without fear of injury to the cable.

VIII.—CONDITION OF THE CABLES.

The general condition of the cables in the subways in the city is very satisfactory. Especially is this true of the high potential electric lighting circuits. There is as yet no indication of deterioration of the lead covered cables, the fibrous insulation retaining its original appearance, and the elasticity of the rubber cables being as pronounced as when the cables were first laid, in many instances from three to four years ago. It now seems safe to say that, barring mechanical or electrical injury, the life of these cables will be equal to that of their lead covering. As the percentage of mechanical injuries to the cables is small, and ruptures of the insulation due to the normal or momentarily abnormal pressures, or to lightning, have been very few, and there having been but one instance of deterioration of the lead covering, the life of the cables may be considered as practically unlimited. The only instance of deterioration of the lead covering of the cables of which the writer has knowledge was found to be due to the presence of ammoniacal salts in a cement lined conduit. It is assumed that the salts seeped through the conduits.



Figs. 17 and 18.

The lead covering of the cables is alloyed with 3 per cent. of tin to prevent injury from the cause just stated. In the cables more recently laid, a thin coating of tin is placed over the lead in addition to the alloy, as a further protection.

The high potential electric light circuits are tested weekly to ascertain the electrical condition of the insulation of the cables. The tests are, as a rule, made inclusive of lamps, converters, etc., but when an indication of trouble appears the cable proper is tested separately. The rules of the subways require the high potential circuits to show an insulation resistance of about 150 megohms per mile, but no difficulty has been found in maintaining it at an average of 500 megohms per mile.

The number of "burn-outs" or grounds on the high potential conductors during the past four years has been comparatively few, and with scarcely an exception those that have occurred have been due to defective joints or to mechanical injury. During the past year the total number of burn-outs was 12, and of grounds 13. With but one exception, the cause of which was unknown, these defects occurred in joints or were due to mechanical injury. In the case of one electric light company, operating over 100 miles of cables, there was not one burn-out or ground during the past year. In the case of another company, operating over 275 miles of cables, there have been but one burn-out and two grounds, due to mechanical injury and a defective joint. In addition to the foregoing, a number of defective joints not amounting to grounds were disclosed and located by the regular electrical tests.

As far as known, there has not been an instance of injury to the underground electric light cables of this city due to lightning. Lightning arresters are used at the entrance of the cables into the subways on a few circuits. The results seem to indicate that such arresters are not necessary.

IX.—HEAT IN THE SUBWAYS.

The presence of excessive heat along the route of the subways, due to defective piping of steam heating companies, threatened to be a source of damage to the cables in the subways, but this has been overcome by improving the construction of the steam pipes at some of the worst places and by changing their route in others; so that now, where in some places the temperature of the subways reached 200° F., it is but little above the normal. Prior to these changes, however, it was found that rubber compound cables could successfully meet the requirements of the subway rules as to insulation resistance, even at the temperature noted. (See THE ELECTRICAL ENGINEER, Aug. 12, 1891, on the "Effects of High Temperatures on India Rubber Insulation.")

The need for the employment of high grade cables, impervious to moisture, in the subways, has been more than once demonstrated when certain manholes and ducts have been temporarily flooded by leaks from adjacent water mains, or from natural springs.

X.—RODDING THE DUCTS.

The apparatus now employed in rodding the ducts preliminary to drawing in cables consists of the well-known screw and socket rod, so long used in chimney sweeping, and a newer device, more of the nature of a coupler, shown in Figs. 17 and 18, and known as the "Hart" coupler. It consists of a flat piece of brass B, attached to one end of a rod, arranged to fit into a slotted piece of brass B^1 on the end of another rod. Each rod, of course, is supplied with a strip and a slot at its respective ends. In coupling up, the flat strip B is held at an angle and slipped into the slot B^1. The rod is then dropped to a horizontal position, when the catch c on B^1 is caught against the inside end of B^1 at x^1 and the reverse catch c^1, or B^1, catches under the remote end of B, at x^1, thus holding the rods together. While this joint or coupling is quite loose, there is no likelihood of the rods coming apart in the duct since the diameter of the ducts does not permit a sufficient movement of the rods to allow the catch c to slip away from x. This device permits of much faster work than the screw and socket rods.

In rodding the distributing ducts, the surface boxes between manholes are opened to allow of manually guiding the rod through the boxes.

The original methods of drawing cables in and out of the ducts have been adhered to, namely, by hand, when the size or the number of cables will permit, or otherwise, by means of a windlass; a rope being, of course, properly attached to the cable in each case.

It has been found quite practicable to draw cables out of ducts when necessary, and to draw additional cables into ducts over other cables. As many as eight No. 4 B & S lead covered cables have been drawn into a three-inch duct. The four-inch duct will contain ten such cables.

SCOTT'S SLIDING SCALE ELECTRIC METER.

BY

W. B. Sisling.

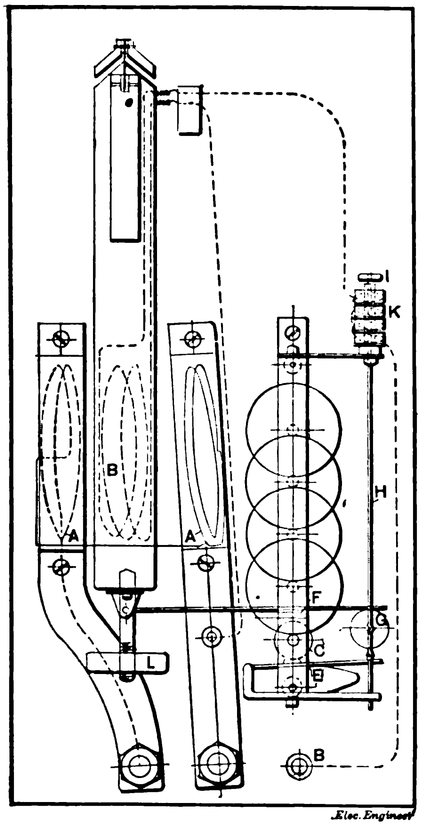
THE problem of the hour amongst electric supply companies in England may be represented by the question, "How can we regulate our charges in such a way as to increase our profit by enlarging our load factor?" The sliding scale based upon the ratio between the lamp-hours registered by the meter and the total number of lamps supplied therefrom (or fixed and connected ready to be switched on if required) has been thoroughly tried in Liverpool with a three-fold range of prices, and an interesting letter from the Liverpool Company's engineer, Mr. A. Bromley Holmes, which appeared recently in the London electrical papers, states that the method had to be abandoned, as it was found that the customers had some difficulty in understanding the scale, that the direct tendency of the arrangement was to limit the lamps fitted by a consumer to the smallest number he could possibly do with, and that the sliding scale was an obstacle to the introduction of the light into churches and other buildings not often used, but which might, nevertheless, be used during a time when the supply plant was not fully worked, as, for instance, on Sundays.

To overcome some of these objections, Prof. Kennedy has suggested the use of an instrument which would record the maximum current carried at any time during the quarter by the meter in connection with which it is used. This would have to be re-set quarterly by the inspector in the same way as a maximum and minimum thermometer. The sliding scale would then be based upon the ratio between the readings of the meter and of the maximum current recorder, and would thus place no restriction upon the number of lamps fitted up by the consumer but only upon the number used simultaneously. Thus far it would probably be quite satisfactory. But sundry small difficulties would have to be overcome.

The starting of a shunt motor, or the blowing of a fuse, might seriously increase the indications of the instrument, and therefore the price per kilowatt-hour for the whole quarter's supply. This difficulty might probably be overcome by using the heating effect of the current to operate the indicator, so that it would not register a momentarily increased current. Further, as the inspector would have to re-set the indicator, the company would have to rely entirely upon his integrity in resisting the bribes of any customers who might feel less anxious to act honestly than to wipe out the record of a dinner party rate of consumption.

Supposing, however, that these and similar small difficulties are overcome, does either this sliding scale arrangement, or the somewhat similar one suggested by Dr. Hopkinson, and referred to in the editorial in the ENGINEER of Nov. 30, tend uniformly to produce a large load factor? I think not, for both systems discourage occasional consumers at all times, whereas it would be to the supply company's interest to encourage them during the times of light load. The right way is, therefore, to cheapen the supply to all customers, occasional or otherwise, during the times of light load, and it seems to me that the problem is solved by the arrangement described below.

The accompanying engraving shows a diagrammatic view of the Scott electricity meter made by Messrs. Laurence, Scott & Co., Ltd., Norwich, England. As originally designed, a self-winding clock was included in each meter, which made it a somewhat complicated and expensive instrument, as the workmanship in an automatic apparatus of this kind must be very good. By doing away with the clock in each meter and arranging one clockwork apparatus in a central position to control the timing of a whole lot of meters, a very simple and practical system is made, which, notwithstanding that a special meter wire has to be laid with the supply mains, works out cheaper in most cases than the ordinary system of meters. The great advantage of the system, however, is that it enables the rates of charge for supply to be made different at different times of the day; this will be referred to further on.



THE SCOTT SLIDING SCALE ELECTRIC METER.

The meter itself is very simple, as will be seen from the diagram which shows all the working parts. Here A A are the fixed series coils of strip copper through which the current to the lamps flows. B represents the movable shunt coil whose resistance is about 1,500 ohms ; B is the terminal to connect to the special meter wire. C is the friction roller geared to the indicating train. E is a brake to prevent the friction roller C from being turned round otherwise than by the proper action of the meter. F is the friction pad which, when lowered onto C will communicate to that roller, and thus to the train, any movement of the suspended coil B. G is the roller on a vertical carrier H which is lowered when the armature I of the little magnet K is attracted. L is the adjusting weight.

The meter wires in connection with the terminal B are periodically connected up to the lighting mains by clockwork at the central position, or by a relay operated therefrom, so that a shunt current is periodically sent through the suspended coil B and through the little magnet coil K, pulling down the pad F into gear with the friction roller C, and thus communicating the forward movement or "deflection" of the suspended coil B to the roller C, this movement being exactly proportional to the current flowing in A A when the difference of potential at the terminals of the shunt coil is constant. When the shunt circuit is broken by the central clockwork apparatus, the friction pad is lifted off the roller C before B commences its backward movement, so that the indicating train is only moved in one direction, and the successive forward movements of B are integrated on it.

The meter works on the most accurate principle that is known, and very careful experiments have been made to find out whether there can be any error from the way in which the principle is applied. It has been found that these meters, as shown in the engraving, have an accurate range of over 100 fold, and this could be very much exceeded if there were any necessity for it. The meter is generally arranged to give accurate readings in Board of Trade Units when the shunt circuit is completed every 90 seconds. The shunt current remains on for about 12 seconds.

The central clockwork is arranged to make contacts with six separate circuits of meter wires one after the other, and as the resistance of the shunt circuit of each meter is about 1,500 ohms, 45 meters on each of the six circuits, or 270 meters altogether, can be worked with a total shunt current of 3 amperes. $^7/_{20}$ or $^7/_{18}$ cable is therefore amply large for the main meter wires, one branch wire of $^3/_{22}$ being taken from one of these meter mains to each meter on the customer's premises. For long distances and large numbers of meters a relay can easily be arranged in a junction box which will connect the next length of meter wire to the mains sychronously with the first length. The simplicity and consequent cheapness of this meter will more than balance the cost of the special meter wires in cases where the kind of mains employed permits of these being used.

If, instead of sending a shunt current into the meter once every 90 seconds, this interval is increased to 180 seconds, the meters will indicate only half the current used; the clockwork at the central position can be arranged so that the alteration can be easily affected, and if the alteration from a period of 180 seconds to a period of 90 seconds is made, say, an hour before sunset by the almanac all the year round, and back again at some fixed time during the evening, it is evident that during the whole of the ordinary working hours in the summer, and the greater part of them during the winter, the current will be supplied at half price, making the cost of power from electric motors compare favorably with that from gas engines. During these hours this will pay the supply companies, as most of their plant would otherwise be standing idle.

It may be objected that this "power" load will overlap the "lighting." load, but during this time the current will be paid for at the lighting rate, and there will be many instances where consumers will arrange so that they do not use power at these hours in order to avoid paying the higher rate. It will also encourage the use of *electric power during the summer time only*, as there are many manufacturers who have steam power that they would gladly stop during the summer months, but which they prefer to run in the winter, as they utilize the waste heat for warming their premises.

The periodic shunt currents can easily be made to record themselves on suitably arranged paper on which the time of day is also recorded, so that the record can be examined and filed for reference.

"THE POLE LINES ON OUR BLOCK."

ONE block in Burlington, Iowa, on Jefferson street, the one between Eighth street and Central avenue, now rejoices in 37 telephone, electric railway and electric light poles. They are of assorted sizes, colors and ages.

ON THE EXACT ADJUSTMENT OF STANDARDS OF RESISTANCE AND THE DETERMINATION OF TEMPERATURE COEFFICIENTS.—III.

BY

Elmer G. Willyoung

SINCE the two preceding parts of this paper were written, considerable additional work of the character which has been discussed has been done under my direction, with the previously described, and kindred forms of, apparatus. The results have been even more gratifying than those which have been given.

In connection with the work another new design of the apparatus has been produced which may seem to some to offer points of further advantage. The new design is shown in perspective in Fig. 9. As will be noted, the bridge and commutator are here combined in one piece so that the apparatus is complete in itself. The arrangement is, upon the whole, exactly the same as that shown in Fig. 3, the principal differences between the two being in compactness and simplicity of construction. The two commutators of Fig. 3 are so arranged that but *one* movement is required to effect the commutation, instead of two. This commutator, moving upon the rod C, really consists of two parts, one fitting upon the other. By using the upper head the whole platform is moved and the coils X and S (Fig. 1) are interchanged. By moving the lower head only, the *battery* alone is commuted thus enabling us *perfectly* to eliminate all thermal effects. This is a very important matter as the E. M. F.'s used are all so small that thermal potentials may prove greater than those employed, as was earlier pointed out. *The ability to commute the battery only is, consequently, of vital importance if good results are to be attained.* The pattern shown in Fig. 3 accomplished this by four movements (Fig. 5) as was shown; the new design, therefore, enables us to save two movements.

The two accessory coils S, Fig. 3, are here mounted in much the same way, but their terminals simply drop into mercury cups instead of being gripped by binding posts. The two coils under comparison are placed at the sides as before; by means of the binding posts a coil may be placed in multiple with the standard in determining the resistance of the bridge wire by the second method. (See Part I, p. 592, Vol. XIV.)

The bridge wire is permanently a part of the apparatus; it is 20 cms. long. The slider is provided with a vernier by means of which the wire may be read to $\frac{1}{20}$ mm. A very fine adjustment of the slider may be obtained by means of the screw nut attached to the rod upon which the slider usually moves but to which it may be rigidly clamped if desired. In order to have as low a resistance bridge wire as may be necessary, shunts are used, as in the cylindrical bridge, Figs. 6 and 7. The shunt is a wire of suitable size mounted upon a rubber strip and covered by a little zinc box A; two copper terminals, to which the shunt is attached, drop into two mercury cups so as to shunt the bridge wire. Different shunts may be used for different ranges of work. Each shunt may have stamped upon it the value of resistance of unit bridge wire division obtained by its use. This mode of varying the resistance of the bridge wire is much superior to the employment of a number of wires which may either be bodily changed or with which may be used an adjustable slider which may be placed so as to run above any particular wire desired. The greatest advantage lies in the fact that using shunts it becomes worth while to work down the bridge wire until it is perfectly uniform in resistance; a shunt will then merely lower its total resistance. If the wires are bodily changed either this large amount of labor must be applied to each one or else a different calibration curve must be used for each wire. Another objection would be the difficulty of always getting the same contact resistances at the ends of the wire; if made with mercury they would be variable owing to the instability produced by the contacts of the slider.

The apparatus is very simple to make, all the copper work being ordinary market-copper bars ½ inch square and bent into the required shape, the cups being drilled in the bars themselves. It is also very compact, measuring but 11 by 10½ inches over all.

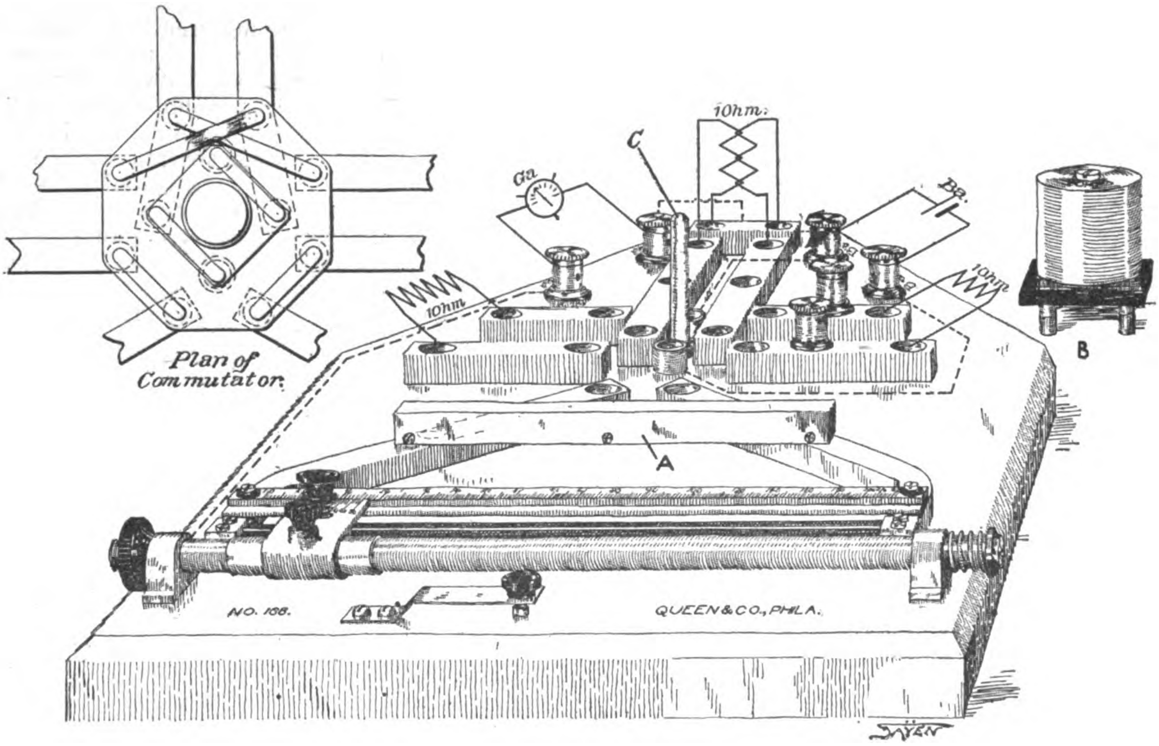
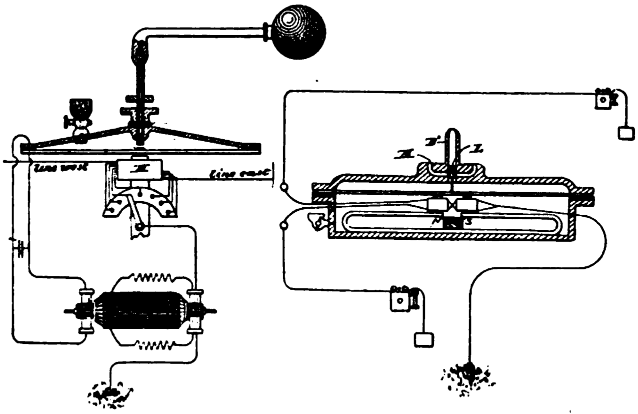


FIG. 9.—IMPROVED BRIDGE FOR COMPARING STANDARDS OF RESISTANCE.

THE FIELD TELEPHONE REPEATER.

In order to increase the distance to which telephonic communications may be transmitted commercially, Mr. Stephen D. Field, the well known electrician, has conceived the idea of establishing communication between several distant points by damping the vibration at one point, and intensifying them at another. The principles of Mr. Field's device will be readily understood by reference to the accompanying diagrams, in which Fig. 1 shows the apparatus arranged at a relay station, while Fig. 2 shows a modification of the vibration producing mechanism at the same station.

As will be seen in Fig. 1, the telephone diaphragm is mounted upon, but insulated from a box, through the top of which extends an air tight tube connected with some device for exhausting the air from the chamber formed by the diaphragm and box, and having its mouth in close relation to the face of the diaphragm. On the upper side of the box is a cup filled with some filtering substance, and provided with a cock for admitting air to the box. Opposite the diaphragm is a polarized magnet with a coil, the terminals of which are connected to the line. The diaphragm and the frame of the box form the terminals of a local circuit including the primary coil of an inductive apparatus, a secondary coil of which is connected with the switch shown, and with the several communicating lines in multiple. The inductive apparatus consists of a shunt-wound dynamo whose armature has a low and a high voltage winding, the former connected with the local circuit, and the latter with the switch and earth, or return. The field magnet shunt is connected with the brushes through which the line currents are led.



Figs. 1 and 2.—Field Telephone Repeater.

Thus, when a partial vacuum is produced in the box the diaphragm will be forced inwardly by air pressure and will stop the opening of the tube which will remain in this condition until sufficient air leaks through the stop cock, when the diaphragm will withdraw by its own resiliency. A further exhaustion will then occur and the opening in the tube will again be closed. This cycle of operations occurs with extreme rapidity. With each opening and closing of the contacts formed at the mouth of the tube the resistance of the local circuit is changed and the dynamo is thrown from a condition of no load to full load; thus vibrations or undulations are thrown upon the lines, of such extreme rapidity as to be above the recording ability of electro-magnetic apparatus. The dynamo is so wound that the local circuit will carry a current having an E. M. F. of about one volt. Between the sides of this circuit is placed a condenser by which the sparking at the contact point may be reduced. Co-operating with the switch are a series of contacts by which more or less of the coil H may be given to the several lines.

For telephonic communication the usual transmitting apparatus may be employed, as indicated in Fig. 2. When signals are thrown upon the line from the distant stations, a disturbance of the balance of the two circuits occurs at the intermediate station and the normal vibration of the diaphragm is interfered with, and this, combined with the reaction between the two sections of the coil H, throws intensified vibrations upon the other line. The rate of vibration of the diaphragm is governed by the amount of air permitted to enter through the stop cock. In this way vibrations are repeated from one circuit into another with great rapidity and a very slight fluctuation at a terminal station is made to produce a very considerable change at the intermediate station.

INSULATED ELECTRIC CONDUCTORS.—XV.

BY

James Bowstead

The substances which can be used for insulating paints are quite numerous. In fact, nearly all kinds of insulating material may be thus used. To state it broadly, any insulating material which will form a *chemical* solution with a solvent containing no water, whether the solvent be simple or compound, and the solid ingredients of which do not separate during the evaporation or other change of the solvent when the solution is exposed to the atmosphere, will form paint of more or less value. But the number of such compositions which will meet the requirements of a first-class insulating paint is comparatively small. Referring to the above broad statement, the writer would state that there are many solid compounds which when dissolved in a volatile solvent form what *appear* to be chemical solutions, yet, when a layer of the mixture is exposed to the air, the solids will separate. This frequently happens when such paints contain paraffine wax as an ingredient. Again, there are many solutions which are chemically one so long as they remain hot, but the ingredients of which separate as soon as the solutions cool. Such materials should never be used for dielectrics.

There is an important fact relating to solid insulating material which is not generally known, and which should be remembered by manufacturers of insulated wires, namely, that most solids and perfect combinations of solids when applied by means of suitable solvents form bodies which are more compact, which adhere better, and which have a higher melting point than when applied while in a melted state. To illustrate: Take asphaltum four parts and rosin one part, and melt together. While the compound is in a liquid state apply, by means of a brush, a portion of it upon a tin plate, say, so as to form a thin layer. Then take another portion of the compound after it has cooled, make a varnish by dissolving it in naphtha, and apply to the same tin plate. The varnish may be used either warm or cold. After it has hardened it will be found, upon examination, that the compound which was applied in solution is harder to detach from the plate, is more tenacious, and requires a higher temperature to soften it than that which was applied hot. There has been no change in the material itself, and the difference in the properties of the two bodies is mainly owing to the fact that in one case the intermolecular spaces have been enlarged by heat, and in the other they have not, and the molecules therefore remain closer together both during and after the process of hardening. The above statement will apply to the majority of insulating compounds which have very low melting points; but the application of such compounds by means of solvents is not always advisable or necessary.

While treating of substances which can be used in the fabrication of insulating paints only such properties possessed by the substances as render them suitable for this particular purpose will be herein briefly enumerated. Other properties which the same substances possess and which adapt them for use in the formation of other kinds of dielectrics will be mentioned in the proper place when considering the production of such dielectrics. To name and describe *all* the substances which could be used in the manufacture of any one class of dielectrics would require too many articles; therefore but a few of the principal ones will be selected for illustration, and these will give the reader a general idea of the materials which may be used to form the various kinds of dielectrics.

Copal. This is one of the best and most permanent resins known. When properly prepared its specific resistance is about that of colophony. On account of its extreme hardness and brittleness it should be combined with material which will render the combination tough and flexible, as desired. Its proper solvent is pure linseed oil; and when it is once dissolved in oil it will combine directly with almost all other substances and compositions which are dissolved in the same oil. There are a few volatile solvents, simple and compound, of copal, but as the quantity dissolved by them is so small the solutions are of no use except for thin varnishes. Copal, in certain proportions, readily unites by heat with most resins and waxes, and when thus combined it can be more easily dissolved in oil than when used alone. To make a perfect solution of copal in oil requires considerable practice and skill, but if the following process is successfully conducted the resulting solution will be a clear and *permanent* one. Take a quantity of copal and separate it into different portions according to color, *i. e.*, place all the clear colored pieces in one pile, the dark pieces in another, and so on through the intermediate grades. *This is necessary* because of the different melting points of the various colored pieces. Then take any one pile and melt it over water, the heat being *above*, and allow the melted copal to drop into the water through perforations in the bottom of the containing vessel. Melt the other piles in the same way, and after all are melted, collect the mass, grind or crush to a coarse powder and dry *thoroughly* in a current of hot air. The copal loses weight during this treatment, but the resulting product is the pure resin which is now ready for use. To dissolve, carefully melt a convenient quantity in any suitable vessel, and have some boiling hot linseed oil ready in another vessel; when the copal is thoroughly melted pour the oil slowly into the melted mass and stir continuously until the copal is dissolved. If the loss of the copal resulting from this treatment is an objection to its use—for the loss sometimes amounts to as much as 25 per cent.—the copal can be dissolved in another way, but the result is not as good at that produced by the first method. To do this, melt the copal and add a large proportion of common resin to it. To this compound may be added other resins and waxes, and, if the copal is of an inferior quality, bituminous matter. While the compound is still liquid boiling linseed oil is added in the manner above stated and the whole boiled for from three to four hours. When sufficiently cool, turpentine may be added to thin the paint, but the less volatile the solvent in insulating paints the better.

The addition of copal solutions to other paints causes the resulting paints, when dry, to become harder, more brittle, more durable, and to have a higher melting point. But it also causes them to dry more slowly.

THE PRENTISS INCANDESCENT LAMP.

In order to afford ready access to the interior of incandesent lamp bulbs for the purpose of renewing broken or burned-out filaments, Mr. T. H. Prentiss, of the Buckeye Electric Co., has designed a method of making a portion of the bulb of a softer glass than the remainder, so that the glass bulb being separated into two parts on a line passing through the section of softer glass by means of any cutting tool, or by cracking, may be reunited by fusing, after the substitution of the new filament. The portion of softer glass forms a section of the bulb below the metal cap, so placed that after separation easy access can be obtained to the points of connection between the filament and the platinum wires.

ROTATION OF THE MAGNETIC FIELD.

BY

Chas. Steinmetz.

A part of space, where magnetic forces are acting, is called a *magnetic field of force*. The magnetic force at any point of the magnetic field is—analytically as well as physically—represented completely, in all its inductive and mechanical effects, by two quantities, the *intensity*, and the *direction* of the magnetic force. In Faraday's geometrical representation of the magnetic field the *density* of the *magnetic lines* corresponds to the *intensity*, the *direction* of the magnetic lines to the direction of magnetic force. Consequently, as long as the two characteristic quantities of the magnetic field, the *intensity* and the *direction* of the magnetic force, are *constant* in any point of space, the magnetic field must be said to be *stationary and constant* at this point of space, and any representation of the magnetic field which does not conform to this, has to be rejected as not giving a correct representation of the phenomenon. While on the other hand, if intensity or direction of magnetic force at any point of space vary in time, the magnetic field at this point is a variable function of time, which may be a periodical function, or not.

Now let us examine the case of a cylindrical, uniform magnet, revolving around its axis, either a permanent magnet, or a cylindrical iron core with a concentric magnetizing helix, in the latter case both, or only the core, or the helix revolving. In any one of these cases, intensity and direction of magnetic force are constant functions of time, that is, stationary, at any point of space, and consequently the assumption of any rotation of the magnetic field is not warranted.

In the case of a horseshoe magnet revolving around one of its legs, the magnetic constants at any point in space are periodical functions of time, and at all points of a circle concentric to the axis of rotation. These functions are identical, but differ in phase progressively; but this does not involve the rotation of the magnetic field any more than the tides of the ocean—which are periodical functions of time, differing in phase in space—mean a rotation of the waters of the ocean around the earth.

THE ELECTRICAL CONGRESS.

Dr. Elisha Gray, chairman of the World's Fair Electrical Congress, has issued a call to his Advisory Council for a meeting in New York on Januray 17, when two reports will be considered and acted upon, as determining the Congress programme—one from the English Committee and the other from the Congress Committee of the American Institute of Electrical Engineers. Both these documents have been put in type and distributed to the members of the Advisory Council in this country in advance of the meeting, so that the work can be actively prosecuted as soon as the Council has closed its session on the 17th.

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T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
Western Editor and Manager, L. W. COLLINS. 575 The Rookery, Chicago, Ill.
New York Representative, 208 Broadway, } W. F. HANKS.
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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 208 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XV. NEW YORK, JANUARY 11, 1893. No. 245.

MR. TESLA'S HIGH FREQUENCY WORK.

IT is now nearly a year since Mr. Nikola Tesla, after his brilliant demonstrations here, scored such decided triumphs in the lectures which he delivered abroad at the invitation of various scientific societies; yet the interest which is manifested in his recent work not only by electricians but by many laymen, is such as to make highly welcome the publication of the abstract of Mr. Tesla's lecture, prepared by him for, and just published in, the Transactions of the Royal Institution of England. In this abstract, Mr. Tesla gives a succinct account of the reasonings and experiments which led up to the results obtained by him, and, taken altogether, they present a remarkable array of experimental facts in a field entirely new. Although replete with facts and suggestions, many of them quite new, it must be evident that the paper embodies but a tithe of Mr. Tesla's work in this field, the complete record of which would fill more than one volume of surpassing interest. Those who attend the convention of the National Electric Light Association in St. Louis, next month, will have an opportunity of witnessing some of Mr. Tesla's experiments in a lecture which he has consented to deliver before the Association.

EMANCIPATING THE CANAL MULE.

IN his message to the Legislature, Governor Flower, of New York, remarks that only steam canal-boats capable of towing three to five boats each trip are now able to compete successfully with the railroads in the transportation of freight, and he suggests the inquiry, whether by the application to the canals of the "deadly trolley," it might not be possible to increase the speed of transit from the present average rate of two miles per hour to the maximum which is possible without injury to the banks of the canal, which is about four miles per hour. He points out that abundant water-power for the purpose is available at many points along the line of the canals, which might be utilized at a comparatively small expense. He thinks the electric plant should be owned by the State, and expresses the opinion that the necessary power could be supplied to each boat at a price not exceeding sixty cents per day. We agree with the Governor that the scheme ought to be tried, and we believe it to be perfectly practicable. Doubling the speed would increase the carrying capacity of the present canal fourfold, and would at the same time enormously diminish the cost of conducting transportation. Let the patient canal-mule be emancipated. His brother, the car mule, was freed long ago by the trolley.

SLIDING SCALE ELECTRIC METERS.

THE problem of bringing up the load of a central station to as uniform a character as possible ought to be as much the concern of the station manager as that of increasing the existing maximum. Indeed his efforts in this direction ought to be, if anything, concentrated on securing a uniform load diagram for reasons which are too plain to need further remark. How to encourage the consumption of electric energy during the present light load hours has been the subject of serious consideration, and has with us in America found a ready solution in many cities by the large and increasing number of motors connected to central stations. But in England where the advantages of the electric motor are still slow to be recognized, special inducements have to be offered to consumers to use current during the present light load hours; and the most enticing of these is a reduction of the charges for current during light load hours. How to differentiate current consumed during the periods of light and heavy load, was a problem of no small difficulty. The method suggested in the Scott sliding scale meter described by Mr. Wm. B. Sisling, will therefore prove of interest as offering one solution of a problem which may have to be met by not a few even among our own stations in this country.

LAMINATION IN ELECTRICAL APPARATUS.

IN last week's issue we began a series of articles from the facile pen of Mr. Thomas D. Lockwood, on a subject, the importance of which it is hardly necessary to dwell on, in view of its far reaching character in the construction of electro-magnetic apparatus. This brief sketch, historical and technical, of the lamination of iron in such apparatus, will, we are sure, prove of the utmost value to workers in the field of electrotechnics, and the exhaustive research bestowed upon it by Mr. Lockwood, furnishes a valuable record.

The Index for Volume XIV.

THE index for Volume XIV, accompanying this number, will be found useful on account of its careful subdivision of subject and complete cross references. In its variety of contents enumerated and in the large number of authors it includes, remarkable evidence is given of the wide and growing range of electrical work and investigation.

CENTRAL STATION ECONOMY.

BY

Francis B. Crocker

I DESIRE to express my appreciation of Mr. J. H. Vail's articles on "Increased Commercial Efficiency, and Higher Economy in Central Stations," which appeared in the ENGINEER during November and December. These articles are examples of the valuable contributions which competent and experienced engineers can make to their brethren, and which tend more than any other one thing to improve electrical practice.

I fully agree with Mr. Vail in that while large direct-connected engines and dynamos are, of course, very economical and desirable in themselves, nevertheless there are two other important facts to be considered. The first of these is that the generating plant must be divided into several separate units, since we cannot depend upon a single large unit for fear of a break-down. Consequently, we can only use large units where the load is large, that is, several times as large as any one unit. This refers to the total or maximum load.

The second fact is that large (particularly triple expansion) engines are very inefficient at light load; which is apt to be the case. Consequently we should not employ very large units when there are long periods of light load, which is apt to be the case in electric lighting.

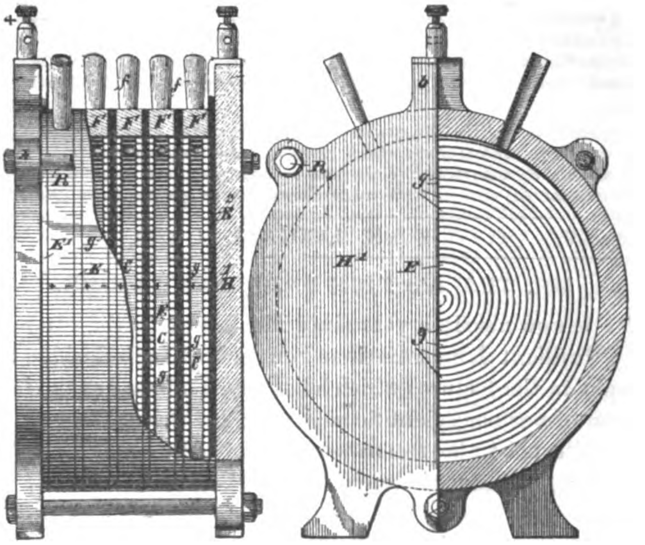
In view of these facts, Mr. Vail states that stations of medium capacity should be equipped with two or more smaller engines for service during the hours of small load. It has always been an inexplicable matter to me why this plan is not more often adopted in electrical generating plants. It is even possible to divide the time into two or more periods, and the size of the units can be made to conform to these periods within reasonable limits. I know of a case where a comparatively small engine and dynamo carry the load during the day and late at night, and a large engine and dynamo are used for the heavy load during the evening. In each case the engines run at about three-quarters load during most of their respective periods, the results being that both convenience and economy are secured. If both units were of the same size, which is the ordinary, stupid plan adopted, then one unit would be underloaded, and therefore inefficient for the day load, and both units would be required for the night load, and they too would be underloaded most of the time.

In connection with discussions of this sort there is one common, but very natural fallacy, and that is, to consider *percentage* of efficiency only and not the actual loss. Taking, for example, Mr. Vail's table of the "Comparative Commercial Efficiency of 2 × 50 K. W. Generators under Various Loads," we find that at 11,900 watts load the commercial efficiency is given at only 47.7 per cent. This *sounds* very low, but if it be remembered that the total indicated horse power in this case is given as only 18.22 and the *total loss* therefore is less than 10 h. p., then it is seen that the actual cost of running the plant at this low efficiency over and above what would be required at perfect (100 per cent.) efficiency is probably about ten cents an hour, which is insignificant compared with the total expenses involved. A difference of five per cent in efficiency at maximum load, which is given as 166.3 IND. H. P. would amount to about as much as the 52.3 per cent. loss at the light load. To take an extreme case: An engine running without any useful load and consuming, say, 10 H. P. in friction would have *zero* efficiency but the actual loss might be much less than in the case of another engine running with a large load at 75 per cent. efficiency. It is a question of the *total cost per annum* of running a station and not what is the *percentage* of efficiency at any particular time. It is, indeed, a fortunate thing that a large *percentage* of loss at light loads is a small matter in actual cost. In the case of electrical *conductors* on the other hand the largest percentage of loss is at the largest loads; consequently the total actual loss is great.

THE WLADIMIROFF ACCUMULATOR.

AN accumulator in which the same electrode forms the positive pole of one cell and the negative pole of the adjacent cell has recently been devised by Mr. Nicholas Wladimiroff, of St. Petersburg.

The battery which is shown in section and inside elevation in the accompanying engravings, consists essentially of two heads or head plates, H, and H', of a series of frames, F, each provided with two feed apertures for the reception of glass feed funnels, *f*, for supplying the acid solution, and a series of electrodes, E, of which there is one between each two frames, whereby the cells, are formed, the initial and terminal electrodes, E' E², of the series being secured between the corresponding frames and the heads, respectively, against which latter they bear, the whole being firmly united by means of tie rods. The electrodes have both of their opposite surfaces of like chemical nature and have a spiral groove formed in their opposite faces, for the better retention of the active material by means of which the latter is formed into a spiral column provided with a continuous or unbroken support, and by which the active surface of the electrode is materially increased.



THE WALADIMIROFF ACCUMULATOR.

IMPROVEMENTS IN ELECTROCUTION.

WARDEN BROWN, of Sing Sing Prison, in a letter to Governor Flower under date of Dec. 19, regarding the execution of McGuire, says: "By a new and modern appliance of electricity applied to the execution of this man, the shock was reduced from 1,800 volts to 150 volts within three seconds, and one contact was sufficient to make life extinct. This modern appliance, which has grown out of experience learned by the electrocution of ten men, does away with all possibility of any burning, scorching, etc."

It is reported that a complete electrocution plant, embodying all the latest improvements, will be shown at the World's Fair, on the instigation of Mr. Gerry.

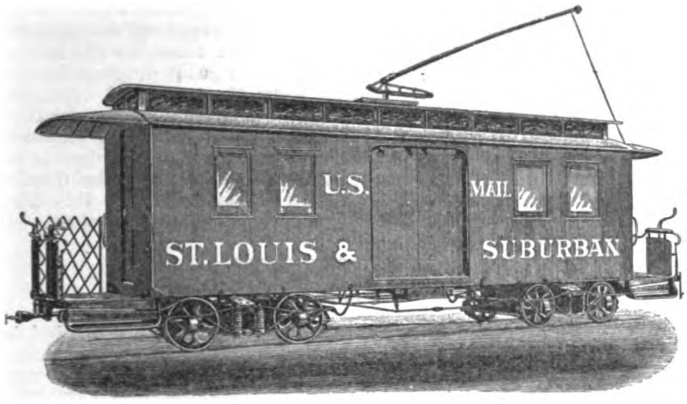
WHITTIER BELIEVED IN ELECTRICITY.

THE inventory of the estate of Mr. John Greenleaf Whittier (amounting in value to $133,730) shows that the greater portion was invested in various railroads and electric stocks, and that the money was so distributed that over 100 different investments were on the list, the amounts being about the same.

ELECTRIC RAILWAY DEPARTMENT.

THE ELECTRIC MAIL CAR IN ST. LOUIS AND OTHER CITIES.

THE proposition to establish an electric conduit trolley system for the dispatch of mails between New York and Brooklyn has attracted public attention to the increased facilities afforded by electric traction for the expedition of the mail service in general. In some cities, the cable cars are utilized for the purpose, and those on the One hundred and Twenty-fifth street line in this city are so labeled. The Elevated trains also carry mails, in a very loose and slipshod fashion. But it is with electric trolley cars that the best opportunities present themselves, and perhaps St. Louis is the most conspicuous example of their use. The cut shown on this page illustrates the special mail cars used on the St. Louis and Suburban Railway Company's lines. Mr. Thos. F. Sneed, the general superintendent, writes us that the car travels over a system embracing 19 miles, making three trips daily. Baggage matter is also handled with the mail matter. The car is constructed on the regular U. S. Postal Car plan, all the arrangements being complete for receiving and distributing mail while *en route*. The aggregate run of the car in making its three round trips is 114 miles, and the time occupied on each trip is 3 hours 12 minutes. The car leaves the post office at 6.25 a. m., for its first trip, and arrives at Cabanne at 7 o'clock. It is met at ten or eleven way stations by the carriers assigned to routes in the adjacent districts and exchanges of mail are made. Returning, the car leaves Cabanne at 9 o'clock, and mail is delivered at the post office at 9:33; and at 9:50 the car starts on another trip. By this means mail is delivered much more promptly in the sections of the city which can be conveniently reached from the St. Louis and Suburban road. The two postal clerks are busy all the time sorting and stamping, and in the process of distribution. The mail for delivery at stations along the car route is at once, after stamping, handed out again at the proper station. It will be seen that by means of this post-office car, letters intended for city delivery will not go through the tedious and dilatory routine of being first taken to the general office, stamped and then sent out again by carrier. City letters can be delivered in half an hour, and all letters can be speeded to their destination with a saving of some hours.



ST. LOUIS ELECTRIC MAIL CAR.

As to the baggage or freight service, Mr. Sneed remarks that it is strictly local, and in no way affiliated with that of any outside company. The street railway charter only permits the carriage of family supplies, excluding coal, and that only west of Vandeventer avenue where the line connects with the "Old Steam Division" right of way. The mail matter, however, is now handled over the entire length of road.

The car itself has regular motor and trolley pole equipment. Inside it is fitted with mail boxes, hooks for pouches, etc. It is 44 feet in length; 7 feet 10 inches wide; 11 feet 4 inches high; length of car body 36 feet; height inside at centre 7 feet 9 inches; opening of side door 4 feet.

It seems worthy of remark here that such a utilization of the trolley and cable tracks in New York should do much to expedite the now disgracefully slow mail service. There is no longer any certainty in the delivery of letters, while newspapers are like bread cast upon the waters—it is many days before they turn up. While the present article was being prepared, its writer received a paper mailed down town 30 hours before; and the same delivery has often taken more than two days. Evidently it would expedite things to abandon mail wagons as far as possible and concentrate postal energies on the street cars. That would be at least one measure of relief in many of our rapidly growing cities. Postmaster Harlow of St. Louis is understood to be well satisfied with the results. There is a further interesting feature of the case, suggesting a possible extension of the idea. While the great strike was on in New Orleans recently the mail authorities were advised to have the street cars defined as mail handlers, inasmuch as letter carriers were obliged to employ them for prompt distribution. The scheme met with favor, and papers are being drawn up covering the matter and are to be forwarded to the Postmaster General. Postmaster Eaton will be asked to consider the advisability of placing letter boxes on all street cars, and thus they will be made to serve Uncle Sam as well as the public, and at the same time be under Government protection. In such an event no such thing as a street-car strike, involving the summary stoppage of the cars, would be practicable. The car lines, in New Orleans are being rapidly converted into trolley systems.

A SWEEPING TROLLEY VICTORY IN PHILADELPHIA.

THE Supreme Court of Pennsylvania rendered a decision on January 3, in the trolley cases, and the judgment was a complete victory for the Philadelphia Traction Company, which is authorised to build an electric trolley railway system over nearly 100 streets in the city. The opinion of the court was delivered by Justice Mitchell.

In brief the court states that the questions submitted for its decision were: First, has the Legislature authorized the railway companies to do the acts complained of; and second, if so, has such authority become operative by the consent of the municipal authorities validly given? Upon the first point the court finds that the act of May 8, 1876, authorizes passenger railway companies in cities of the first-class to substitute other than animal power whenever authorized by city councils, and contrary charter limitations are repealed. The court finds that this act is constitutional, and supplies the authority wanting in the charters of the several companies. Upon the point that the consent should have been given to the Traction Company, the lessee of the several companies to which the authority is actually given, the court holds that the lessee and lessor are, to all intents and purposes, one corporation, and "the circumstances leave no room to doubt that the consent of councils was that the thing should be done by the two corporations acting together as one; and such consent, whether it named one or the other, was meant to be operative as to both. This is the common-sense view of the action and intent of councils, plain to all men."

This decision establishes the validity of the seven ordinances of March 31, 1892, granting the trolley franchise to the Union, Continental, Philadelphia and Gray's Ferry, Catharine and Bainbridge, Thirteenth and Fifteenth Streets, Twenty-second Street and Allegheny Avenue and Empire Passenger Railway Companies. These ordinances were vetoed by Mayor Stuart and passed by councils over his veto. They provide, after enumerating the streets to be occupied: "Said motors to be supplied from overhead wires, supported by iron poles not less than 20 feet high, which the said company is authorized to erect and maintain, and to be placed opposite each other, within the curb lines, and connected with street wires, or at the option of the company to be erected in the middle of the streets with a double bracket thereon suspending the overhead construction. Provided that in the construction and operation of the system of wires and poles herein authorized, the same shall be so constructed and operated as not to interfere with the construction and operation of any elevated railroad heretofore authorized by councils. The same shall be under the supervision of the Director of the Department of Public Safety. Before said company shall exercise any privilege hereunder it shall first pay $50 into the city treasury for the printing of this ordinance."

There are no restrictions, limitations or conditions in any of the ordinances, except as mentioned above. The agreement to pave 40 miles of streets, presented to the mayor and to councils, was never accepted by the authorities, and there is now no legal obligation upon the Traction Company to do this paving. President Widener declares, however, that the company will live up to its agreement.

With regard to this decision, Mr. P. A. B. Widener says that it will add $100,000,000 to the real estate values of Philadelphia in a very short time. About $5,000,000 will be spent in introducing the trolley system and of that about $1,000,000 will go in new paving.

When asked about the first line to be equipped with the trolley, Mr. Widener said that the extension of the Bainbridge and Catharine streets road along Gray's Ferry avenue to the bridge would be constructed as soon as possible in order to accommodate the thousands of working people employed in that locality. The Morris and Tasker streets line, about being completed, will next be connected by way of Long lane with the road to Point Breeze, which, although finished for some time, has not been operated.

The first main line of travel upon which work will be begun as soon as the weather permits is the Thirteenth and Fifteenth streets road. After this it has not yet been decided on what lines work will first be pushed. It is the intention of the Traction Company, however, to equip all the roads comprised in the ordinance as soon as the necessary material and labor can be had.

In addition to these lines it is the purpose of the company, President Widener said, to ask councils for the privilege of using the trolley system on the Ridge avenue road from the depot to Manayunk. It has not yet been determined what motive power shall be used on the lower end of the line.

The trolley system in operation on Bainbridge and Catharine streets, President Widener claimed, was the ideal system of the country, and it will be the same as will be used by the Traction Company on all its lines. Especial attention will be given to the road bed. Solid rails, weighing 92 pounds to the yard, will be used, and only the most approved materials and best workmanship employed.

The different lines could be equipped with the trolley system for much less than $5,000,000, Mr. Widener said, but it is the intention of the company to spare no expense in securing the very best method of electrical street car propulsion.

A complete equipment of about 1,000 new cars will ultimately be provided, both for summer and winter use. They will have four wheels and be about ¼ larger than the new cars on the Bainbridge and Catharine streets line, but it is claimed that they will not have any rocking or jerky motion, because the weight of the motors will keep them steady, and the solid roadbed will obviate any jolting.

Additional boilers, engines and dynamos will be constructed at the power house of the Bainbridge and Catharine streets road to furnish the current for the operation of the Spruce and Pine, its extension to Fairmount Park and Gray's Ferry bridge, and possibly over that structure to connect with the railway on Woodland avenue or Darby road. Besides these, power will be furnished to the Morris and Tasker, Christian and Ellsworth streets lines.

Another power house is to be located in the northern section of the city, which will supply the electrical current for all the traction lines designated in the ordinance and also for the Frankford and Tacony Railway, which was recently authorized by ordinance of councils. When all the Traction Company's lines are operated by the trolley as at present contemplated, 4,000 car horses will be taken off the streets.

A SLEET WHEEL INSTEAD OF TALLOW.

A UTICA, N. Y. paper says: Superintendent W. M. Sturges, of the Belt Line Railroad, has invented and caused to be patented a new device called the "Sturges Sleet Wheel." Heretofore, when it has been found difficult to operate the cars because of sleet and ice gathering on the trolley wires, men equipped with buckets of grease and tallow, and a long pole on one end of which was a bundle of rags, have mounted the cars and greased the wires. This was quite an ingenious remedy, to be sure, but it was effectual only in part. When ice had already formed it would not remove it, but if applied before the ice formed it prevented any great accumulation. Mr. Sturges's device does more than this. It was tried this morning and proved conclusively that it would remove the ice just as quickly as a red hot iron.

The contrivance is a simple one. It is a wheel, just the size of the ordinary trolley wheel, and in just a minute and half the trolley wheel may be removed and this one placed in its stead. The sleet wheel is made of bronze and is divided in the centre of the groove into two parts. The parts are not solid, but are divided in sections like the old fashioned horse car wheels. On each of these sections is a shoulder which comes into direct contact with the trolley wire, and when the wheel revolves the shoulders scrape the ice from the wire as neatly as a knife. The first cars sent out this morning were not equipped with the new wheels, and consequently were stalled when part way to their destinations. The second run of cars on all the lines were so equipped. They not only made the runs on time, but pulled the stalled cars along with them. On the New York Mills line the sleet-wheel car brought a New York Mills and a Whitesboro car back with it and ran into the yard on time. Superintendent Sturges is confident that nothing but deep snow or broken machinery will interfere with traffic this winter.

COMBINED ELECTRIC RAILWAY AND LIGHTING PLANTS.

BY

C. J. Field

I HAVE noted the article by Mr. McCay in THE ELECTRICAL ENGINEER on the operation of combined railway and lighting plants, and have read it with pleasure and profit. For the past few years we have earnestly, on every occasion, been the strongest advocates and friends of the advantage and desirability of the combination of electric lighting and railway plants in the small class of towns. From our own experience, in the ones we have built, we believe there is no better investment or opportunity of profitable re-organization of many of the small railways and lighting plants which are now operating on a very small margin of profit.

The figures presented in the article in question we have seen demonstrated, and even stronger cases than this. We know of railway and lighting plants which separately, were on a non-productive basis, and which, combined into a new and modern equipment with energetic management, have made a large and profitable return on the capitalization.

The only point I would criticise in Mr. McCay's article, in which he seems to have not had the very latest information on the matter, is in the cost of power operating expenses on properly equipped large plants. I do not consider that the old figures published by the West End Company are a guide or precedent in the matter at all. These figures were the result of operating under very poor conditions. We know of several plants which we have built and equipped in which the power operating expenses were 1½ cents per car mile, and even under; but these figures are on plants of much larger capacity than this one, and the obtaining of practically the same figures on a small plant of this kind can only be accomplished in a combined station of this class.

ELECTRIC RAILWAY CROSSINGS.[1]

THE introduction and growing use of street cars propelled by the trolley system has brought before the minds of railway managers the question of safety at crossings where the electric road intersects other passenger lines. It is a question which frequent accidents make pressing, for the danger of collision is much increased under electric propulsion. One of the main arguments used to gain assent to the substitution of trolley for horse power is that real "rapid transit" will be thereby secured. But cars cannot move rapidly through the streets without doubling the peril of accidents, particularly at crossings with other railroads.

Horse cars seems to have been regarded originally, so far as danger is concerned, as only a modified form of wagons and other horse conveyances. Their lines cross each other at the will of the promoters, it being thought apparently that horse cars could stop as easily as wagons, and needed only to be governed by the same rules of the road. But rapid transit alters the case; faster cars demanded and promised as a recompense for the permission to use electric motors, to introduce to a more or less degree exactly the question of safety long debated about steam railroad crossings, and which has by general demand been partly solved through the use of safety appliances. As the use of trolley cars continues to extend through city streets or country roads, safety to the public will surely require, as on steam railroads, that crossings be protected by the best apparatus. Already we have a long list of collisions, attended always with loss of property or injury to persons, and often with loss of life, where a trolley car ran into another electric car at a crossing, where cable and electric cars collided, or where trucks and teams have been struck while crossing at right angles along a public street. This is one more reason why the trolley should not be used in crowded streets like those of New York City, but it is also a reason for greater precaution in any street or road where the electric car has been introduced and where other streets or roads cross the electric tracks. Speed has its advantages and is a rightful aim in its proper place, but clearly it has also its obligations as to protection for the public safety.

An important part of the subject is the crossing of a steam railway by an electric road. The whole matter of steam railway crossings at grade is a complicated one, particularly as to the division of the expense of removal; yet the feeling is growing that the crossing of a steam railway by a wagon road at grade is such a source of danger that sooner or later some way must be found to do away with it. If this is true as regards the ordinary traveled highway, it is doubly true in cases where the electric car at high speed crosses the steam tracks. No mere flag-waving can insure safety in such a case. In advance of the removal of the grade crossing through the elevation of the steam or the wagon road, such an electric crossing ought to be protected by the best known automatic appliances, including the modern device of derailing contrivances working automatically in the presence of danger. Since all accounts agree that the trolley system of propulsion when allowed on streets or roads is very successful financially, yielding large returns to the companies beyond the interest on the cost of substituting electricity for animal power, it is proper that those profiting by the new motor should guard the public at their own expense. In short, the trolley companies ought to be compelled to pay for the needed safety apparatus, and provision for the protection of the public ought to be a part of the regular estimate of cost made in changing old lines or building new ones. It is generally recognized that electrical propulsion in some form will undoubtedly be the future power for street and road railways; it is important that now, before the field is entirely turned over to electricity, we should provide adequately for the dangers which rapid transit invites. We cannot have advances in passenger carriage without the accompanying drawbacks, but we can at least insist that wherever the fast car travels, it shall find the public safety everywhere guarded by the best appliances known.

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[1] New York *Evening Post*.

CONSOLIDATION OF ELECTRIC RAILWAY INTERESTS IN BROOKLYN.

THE details of the plan by which the Brooklyn City Railroad Company, with its $12,000,000 of capital and its 83 miles of street railroads, is to be leased to a syndicate to be known as the Long Island Traction Company have been made public in a long statement issued by President Daniel F. Lewis. Prefacing his statement, Mr. Lewis said that many offers for control had been made and declined, but that one had now been submitted which he thought would be of great benefit to the stockholders.

The proposers, whose names he declined to give, have formed a syndicate and are represented by the New York Guarantee and Indemnity Company. They propose to lease the road in bulk, paying the stockholders 10 per cent. a year on their holdings, and depositing $4,000,000 with some trust company as a guarantee. The statement continues:

"The syndicate is to give to the stockholders of the Brooklyn City Railroad Company the right to purchase three shares of the traction company's stock of the par value of $100 each for every 10 shares of the par value of $10 each held by the stockholders of the Brooklyn City Railroad Company at the date of the delivery of the lease, at $15 per share; when the holdings of any stockholder of the city company shall be less than 10 shares he shall be entitled to his proportionate share of traction company stock in scrip.

"The capital stock, to begin with, will be fixed at $30,000,000, and this arrangement will place in the stockholders of the Brooklyn City Railroad Company $\frac{9}{10}$ of the capital of the traction company; the remaining $\frac{1}{10}$ will be allotted to the members of the syndicate, but shall be paid for at the same rate as that paid for by the stockholders of the Brooklyn City Railroad Company. This arrangement will place the control of the traction company by a large majority in the hands of the stockholders of the Brooklyn City Railroad Company.

"The right to subscribe for the $3,000,000 of the capital stock of the Brooklyn City Railroad Company (after the present $3,000,000 about to be issued to the stockholders are taken by them, the issue of which is authorized) is to remain with the stockholders of the Brooklyn City Railroad Company, and will no doubt be issued to them at par during the year 1893.

"The surplus in the treasury of the Brooklyn City Railroad Company at the date of the delivery of the lease will be divided in due time among the stockholders of the Brooklyn City Railroad Company.

"Rights to purchase the stock of the traction company and to subscribe to the unissued stock of the Brooklyn City Railroad Company will be arranged so they may be disposed of by stockholders not wishing to make the purchase or subscription."

THE LEBANON, PA., ELECTRIC RAILWAY.

THE LEBANON AND AMESVILLE ELECTRIC RAILWAY at Lebanon, Pa., is said to be one of the most complete in the country in point both of construction and equipment. The charter was granted in 1890, work was commenced in the spring of 1891 and the first car was run over the first section on August 17, of the same year. The entire road was completed last September. The capital stock, originally $60,000, was afterward raised to $100,000, and during the past summer $100,000 of five per cent. bonds were issued, all of which have since found ready takers.

Encouraged by the success of this road, the Lebanon & Myerstown Electric Railway Company has now been formed with $100,000 capital stock. The charter has been secured, all damages settled and the new road, which will be seven miles long, will be commenced in the early spring.

AN ELEVATED ELECTRIC RAILWAY FOR PARIS.

IT is stated that a syndicate of engineers has applied for the privilege of constructing an elevated road in Paris to be operated by electricity. The project divides the city into two parts by a line running north and south. A new street, 165 feet in width, will be built, which will open into the principal quarters, the Bourse, the Halles Centrales, the Palais du Senat and the Jardin des Plantes. The central part of this route will be reserved for the elevated line, which will have two tracks resting upon four rows of iron columns, 23 feet in height. The projected line will connect with the Metropolitan railway and with the important lines which already exist.

TROLLEY ROADS FOR RURAL NEW YORK.

THE building of electric railroads through Westchester County is occupying the attention of the people in all the towns where they may be put in successful operation. It has been suggested that it would be a good investment for the local capitalists to connect Verplanck's Point, Montrose and Centreville with Peekskill by an electric railroad. There is much travel between these points, and the road would be well patronized. The distance is short and several thousands of population would be reached and benefited. Nothing, it is argued, could be done that would give such a stimulus to business in Peekskill as the connecting by electric cars of the small hamlets in the vicinity of this place, which is soon destined to become a city.

Lake Mohegan, a popular summer resort, now reached only by stages, lies on the east, and Annsville, near the State Camp of Instruction, Oregon, and Lake Oscawana to the north and northeast, are all within reasonable distance and are places important enough to be more in touch with the centre at which they get their supplies.

MISCELLANEOUS.

AN IDEAL CENTRAL POWER STATION.[1]—II.

BY C. J. FIELD, AND THE ENGINEERING STAFF OF THE FIELD ENGINEERING COMPANY.

BOILERS.

After the engines, one of the next most important factors of a power station is a good type of boiler. There may be said to be boilers and boilers, many types of them, but if we look carefully over the field we can in general bring them down, as far as concerns a power station of this kind, to three types or classes: First, the plain horizontal return tubular boiler, which has probably been more largely used in power station and mercantile work than all the other boilers combined, and where there is ample space and a working pressure not exceeding 120 or 125 pounds is required this type of boiler probably more fully meets general requirements than any other. Under the second head comes in the sectional or water tube type of boiler as manufactured by Babcock & Wilcox and many other firms in the same line. This sectional water tube type of boiler has been more extensively used, probably, than any other where high pressures were required, and it has in general cases met the requirements of this practice. We found, however, in some particular parts of our work, especially in power work, where the load is subjected to violent fluctuations, that this sectional type of boiler lacks steam room capacity to stand the violent fluctuations of load. This has caused engineers to look around for some other boiler which would combine the advantages of the horizontal return tubular and of the sectional. Without experimenting too much it seemed, on looking over the field, that the boiler which had been so largely developed for marine practice, as the internally fired marine type of boiler, offers the best solution of the difficulty with some modifications and changes. We therefore classify this as the third style of boiler adapted for this kind of work and have used it in this station. Its advantages in development for high pressures have been demonstrated by long experience, also for economy in space occupied, economy in operation and good steaming capacity. Such a type of boiler is described in the following specifications:

BOILER SPECIFICATIONS.

Type.—Internally fired, direct fire tube marine boiler.

Pressure.—To be tight under 160 pounds working pressure and tested to 210 pounds hydrostatic.

Capacity.—To evaporate three pounds water from 100° and 70 pounds pressure (M. E. unit) per square foot of heating surface. In other words, 10 square feet of heating surface per horse-power.

Economy.—To evaporate nine pounds of water from 120° F. at temperature corresponding to 160 steam pressure per pound of good Scranton anthracite pea coal when developing its rated capacity.

Quality of Steam.—The steam furnished by boiler when developing its rated capacity shall not exceed 2½ per cent. of moisture as determined by calorimeter.

Furnaces.—To be of either the corrugated or Adamson type, having a common combustion chamber.

Riveting.—Longitudinal seams of shell to be butt jointed and double butt strapped and triple riveted each side of butt. Circumferential seams to be double riveted. Flanges and heads to be single riveted. All holes to be drilled when sheets are in position for riveting.

Staying.—Boiler to be stayed in the most approved manner to withstand 160 pounds working pressure. Strains on welded braces must not exceed 6,000 pounds per square inch section. Solid stays must not have strains to exceed 9,000 pounds per square inch of section. All stays, braces and rivets to be of the best double refined iron.

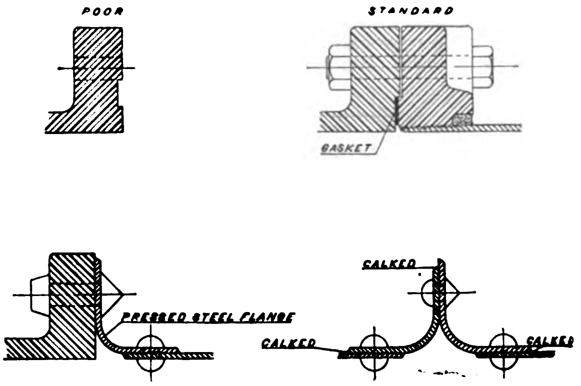
Manholes and Handholes.—Each boiler to have at least four manholes to facilitate cleaning as well as a sufficient number of handholes for the same purpose.

Plates.—All plates to be of the best marine steel of 60,000 pounds tensile strength.

Fronts.—Each boiler to be supplied with neatly designed furnace fronts and cast iron bridge walls.

Fixtures.—Each boiler to be supplied with necessary supporting lugs or saddles, one set of grate bars for each furnace, all necessary dampers, flue and cleaning doors and frames.

Fittings.—Each boiler to be supplied with pop safety valve, steam gauge, water column, gauge cocks and stand pipe, asbestos blow-off cock, stop and swinging check valves and necessary flanges for steam pipe connections riveted to boilers.



FIGS. 5, 6, 7 AND 8.

General Conditions.—Boiler to be set to return the gases to the front underneath the bottom of the boiler. All material and workmanship to be first-class in every respect and certificate of test and inspection furnished.

Remarks.—That the type of boiler here specified has demonstrated its ability to perform its work is unquestioned; not only under the pressure specified and called for in electric service, but even the higher pressures used in the merchant marine to-day; taken in connection with its ability to work under high pressures successfully, it has good average economy. The other point that makes it most fitted for the service mentioned is the small space occupied, together with its enormous capacity or ability to furnish almost any amount of steam when forced, and this, too, of good quality as regards percentage of moisture. This, however, is easily accounted for by the large liberating surface at the water line. The firing of the boiler internally is another advantage offered by this type of boiler, when contrasted with the repairs necessary to furnaces, boiler settings, etc.

PIPING.

Piping is a part of the power station which, in the minds of many people, does not require much attention. We believe, however, that it is one which should receive the most careful and earnest attention of the constructing engineer. The safety, good working and reliability of a power station is dependent on the piping as much as any other factor in its outlay. We have tried to generally outline here, under the head of "piping," a few thoughts and suggestions which are supplemented by some sketches of what has been our practical experience of the requirements in this line.

PIPING SPECIFICATIONS.

This sketch, Figs. 5 and 6, shows a type of joint at flange on pipe to fittings or valves. The flanges are recessed, male and female, for gasket, to prevent the "blowing out" of the same. This effect is considerable if the gasket is thick. The flange is screwed on the pipe and then calked in on the inside. The small recess in the back of the flange around the body of the pipe is to be filled and calked with babbitt or steam metal in case of leakage of screw joint when circumstances will not permit, for the time being, to break the joint and recalk the pipe itself. The threads on the pipe should be cut by the same person, chasing the threads on flanges so as to secure the same taper on both; a very essential condition to a tight job. The screw joint should be made up in plumbago, to be removed, if necessary, at a future time without breaking. The flange should be designed to be equally strong through bolt holes as any other part of the flange. This is easily done by means of bosses about bolts.

There is one thing that should be remembered in the design of cast iron flanges, and that is, that it is hardly possible to get them too heavy for the work. The initial strain due to screwing them on the pipe is so large that the factor of safety that remains is not usually sufficient to withstand the higher steam pressure, together with the increased expansive strains due to the increased temperature at the higher pressure. The weak point in the theory of cast iron flanges is as follows:

Conceive the flange to be made up of laminæ in the form of concentric circles. In case the first lamina is strained beyond its ultimate strength by screwing up, then although no disastrous results will be detected immediately the life of the flange will be very short, and it will fail by cracking, commencing nearest the threads, *i. e.*, at its smallest diameter, and gradually radiating outward. This theory is similar to the one used in the design of hydraulic cylinders, and is equally applicable so far as screwing up the flanges is concerned. From this, one can see that it is possible to screw up a flange too tight; a fact too often overlooked in the anxiety to get a tight job, and usually done when the threaded work is poor.

Gaskets.—Copper corrugated gaskets are all right in the case of mains, where the joints are made up with the ends of the pipe free to move; in fact, they could be omitted altogether in such a case, and the joint made iron to iron; but there is the practical consideration that in case of repairs (and that time is sure to come) the line will be always distorted from its original position; *i. e.*, it will have initial strains, due to some part of it having steam on to run a portion of plant; and when the joint is broken for repairs, it is possible to bring the flanges back in the same relative position they previously occupied, and for this reason alone, I prefer the use of a wire insertion rubber gasket of very thin material, say not over $\frac{1}{16}$ inch thick. This will make up, or rather allow, for this slight inequality of the flange facings, and permit a tight job to be made where a copper gasket or iron to iron would leak.

Another type of connection for high pressure is shown in Figs. 7 and 8. The weak point in these designs is the fact that all calking is done from the outside at the joint, and that it makes a series of small traps for water of condensation. The system would give more trouble after it once commenced to leak than the one mentioned. The use of steel is good practice, and by making such a system with long radius bends of the pipe itself, would give good satisfaction.

Expansion Joints.—The average slip joint will not answer at all for high pressure, for when the packing is adjusted sufficiently tight to prevent leaking, it will also be sufficiently tight to keep the joints from moving to take up the expansion, and if loose enough for this, it will be found to leak.

The corrugated copper expansion joint offers a solution to the difficulty of expansion joints, but when made as most of them are to-day in this country they almost defeat the object they seek to attain. The corrugations in these joints are made literally like the threads of a screw, whereas they should be made without longitudinal pitch, so as to prevent any torsional action tending to make them rigid. Probably the best way to take up the expansion in a high pressure system is by means of long pipe bends of easy radius and with all branches so located, and of sufficient length to take any expansion of the mains by means of their flexibility on account of their small size. Judicious arrangement of this sort can be made without the use of any expansion joints whatever. Under restricted and peculiar conditions copper bends with iron bands can be used with good effect, if commercial considerations are notprohibitive.

Pipe.—Wrought iron or steel lap welded pipe will answer most conditions successfully, even in case of long bends or elbows made from this material. The tests should be rigid to avoid defective seams caused by bending. Extra heavy pipe will not be found necessary.

Fittings.—These should be of the best charcoal iron, true to pattern and of workmanlike finish. The flanges should be ribbed in preference to being thickened up, on account of shrinkage strains in metal.

Valves.—There should be gate valves, operated by an outside screw. The spindle should be of steel, and tinned. The body should be extra heavy and ribbed to prevent any springing, which would cause the valve to leak around the seats when closed. The valve body should be stiffer than other part of the system in order to have all the valves tight. The seats of valves should be bronze or brass, and able to withstand the high temperatures of the high steam pressures, as well as very non-corrodible.

All valves over seven inches diameter of port should have a by-pass valve (a smaller valve about 1½ to 2⅛ inches in diameter) of exactly similar type, so that the pressures can be equalized on both sides of the large valve before it is opened by means of the smaller one. This relieves the excessive strain on the spindles and seats, and should always be used on high pressure work.

Support.—A high pressure steam pipe should always be supported, when possible, from underneath, by means of some solid mass, so that its weight would rest directly upon this support. This method, when it is possible to follow it, will be found to eliminate that vibration so often noticed, and the result of which is leaky joints caused by the racking and straining of the whole piping system. When the suspension method is used there are always one or two points which, if held firmly, will stop the vibration of the whole system. Other positions will cause a general leakage. Experiment will determine these points. Piping should be rigidly secured by proper means.

Bolts.—All bolts should be of double refined iron or low grade steel. Their weakest point is directly under the head, and a good test is to place one in a vise, holding it by the head and bending the shank over by means of blows from a hammer. A good bolt should stand this without showing any cracks whatever at the head. Both head and nut should be hexagonal on account of the limited space in which it is often necessary to use a wrench. The whole system of piping should be blown out thoroughly with steam before the engine connections are made, to prevent any chips or dirt from being carried through to the cylinders.

GENERATORS.

In describing the type of generator required, it is necessary to be more specific as to the class of work it is required to perform, and particularly as regards the voltage, etc., than in our other departments. We will therefore in the main describe, as far as concerns the generator and switchboard, apparatus especially adapted for railway power service.

Generators for electric railway service should be constructed with a view to efficient handling of variable loads and excessive overloads for short periods. They should be mounted on a brick foundation set on a bed of concrete. The top of masonry should be provided with a wooden foundation base; this wooden base to be built up of two layers of timber, with tar paper or some good insulating material between the layers, the first layer bolted by means of foundation bolts direct to masonry, the upper layer being bolted to the lower layer, thus assuring good insulation between the iron foundation frame of generator and the ground. This precaution is taken with a view of protecting the generator from lightning coming in over the line.

Generator Frame in Belted Type.—The foundation frame of the generator should be bolted directly to the wooden cap of the foundation and provided with grooves and sliding arrangement for tightening the belt. The general design of frame and magnets in the latest type of generators of large capacity is a circular casting built up of two or more parts and concentric with the shaft of the machine. The pole-pieces are in many cases made of laminated iron cast direct into this frame; the field wire, both shunt and series, being wound on adjustable spools, which, by suitable flanges and clamps, are bolted direct to the frame when slipped over pole-pieces. The compound field of the machine should provide for sufficient fall in potential due to loss in armature at variable loads, and to maintain a constant E. M. F. at the switchboard. The practice of over-compounding a machine so as to obtain an increased E. M. F. with increased load—in some cases 10 per cent.—is not a good method where a number of generators are in operation, for the following reason:

The machines over-compound in proportion to the load on themselves, and not in proportion to the load on any individual feeder, the result being that if, for instance, two machines are running under condition of full load and have increased E. M. F. 10 per cent. at the switchboard, they may be feeding into two feeders; one feeder which is considerably overloaded, and the other which is very lightly loaded. The result is that the lightly loaded feeder is supplied with a high E. M. F., higher than necessary, and the overloaded feeder is the only one benefited. When a third machine is thrown into this combination the E. M. F. is reduced, as the load is then divided between three machines instead of one, and consequently the overloaded feeder is not assisted to the extent to which it was before.

A better method in large installations is to provide an auxiliary bus which can be connected at any time with any one or more generators, this auxiliary bus to be run at a higher E. M. F., say at 575 volts to 600, and run in connection with it the heavily loaded feeders, or those feeders which are of much greater length than the average of the system. This method reduces the quantity of wire required to run a system and maintain a fairly uniform pressure over the different lines. Arrangements should be made on the switchboard so that any feeder or any generator may be connected to or disconnected from this auxiliary bus, or to or from the main bus, the main bus to be run with an E. M. F. of 500 volts, the same as in ordinary practice. In other words, this divides the switchboard up into two distinct arrangements, electrically separated from each other. This has been tried in practice and has proved very satisfactory.

To return to the construction of the generator, the armature of the machine should be run in self-oiling bearings, made with adjustable globe seats, so as to insure perfect alignment, and provided in the larger sized machine with outboard bearing at the pulley end of the shaft.

The commutator should be of ample width to insure good contact surface between commutator and brushes, for a 500-volt machine. Carbon brushes have proved very satisfactory, and are almost universally used at the present time. The machine should be so constructed that the brushes should not need readjustment for any change of load from zero to 25 per cent. overload. There should be practically no sparking at the points of contact. The generator should be provided with a double pole switch, so as to enable the operator to disconnect the generator entirely from the system when it is required to do repairs, overhaul the machine or shut it down.

The generators should be capable of developing their normal output for a continuous run, and also capable of developing at least 25 per cent. above their normal capacity for short periods without undue heating of any part of the armature, bearings or fields.

There are several methods of connecting the generators with the switchboard.

The three wires from the machine, namely, the positive, negative and equalizing wires are all carried direct to a three pole switch; the equalizing wire is connected to an equalizing bus, and the ground wire to ground bus. The line wire of the machine from the switch is connected to an ampere meter and also to an automatic cut-out, and from there to the main bus. If an auxiliary bus is used the wire, instead of being connected directly to bus, is connected from the automatic cut-out to a transfer switch, which enables the wire to be connected through to auxiliary or the main bus. The main bus is in connection with a main ampere meter, the other terminal of the ampere meter being connected directly to the feeder bus. The feed wires are brought in the station to the switchboard and attached to a single pole switch; from this to an ampere meter, then through an automatic cut-out; then to the feeder bus, each feeder being provided with a lightning arrester. The line wire from the machine above described should be taken from the series field side of the machine, as this series winding affords a very good protectioon from lightning coming in over the line, acting as a very efficient "kicker coil." The ground bus should be connected direct to the rails near the station and also to a suitable ground bus within the station.

To insure an equalization of load between the various generators all the dynamo mains of the same potential should be of equal resistance, provided the machines are of equal capacity, and have a resistance inversely proportionate to their capacity, if of unequal capacity. The usual method followed is to calculate the size of the mains required for the generator farthest from the switchboard; then make the generator mains of the other machines of the same length as this, using the same size wire. In other words, all the positive mains will be of equal resistance, all the negative mains will be of equal resistance, and all the equalizing mains will be equal. It is not necessary to make the equalizing mains of any larger carrying capacity than the others.

Great care should be exercised in making joints between the different instruments and mains, to insure good conductivity, as a poor joint will throw the most careful calculations out. The usual method adopted now for making joints is to use a mechanical clamp having the contact surfaces perfectly clean and of ample surface contact. In operating the switchboard, care should be taken that all instruments required to be used to throw a generator in or out of line should be so arranged that the operator is not required to leave his position at the switch controlling the generator at the board. To obtain this result the voltmeter may be arranged on a carriage which can travel along the length of the board and make automatic connection to any generator as it reaches a position exactly opposite the instruments connected with that generator. By suitable arrangement the voltmeter can be switched, when in position, with the feeder bus, and also with the generator which it is to test, so that without moving the instruments, pressure of the line or pressure of the machine may be taken and the machine brought up to the same electromotive force as that of the line before being connected into service. The automatic regulators on the generator should be adjusted to cut out the generator when the overload of the machine is more than it will safely carry even for short periods. The automatic regulators on the feeders should be adjusted for an excessive overload on that feeder, as in many cases of railway service the feeder is subjected to excessive overloads for very short periods, and it is a source of very great inconvenience to have an automatic regulator continually cutting out the line on overloads of very short duration.

The latest types of switchboards are built up of fire proof material perfectly incombustible. The framework may be built up of iron pipe or of angle iron, and if located near the wall it should be set up at least 20 to 24 inches from the wall, and iron braces from top of frame anchoring into the wall. The general design of this frame is dependent entirely upon the number of instruments and their location on the board, as care must be taken that, with the present method of back connections on the instruments, the cross bars of the frame do not interfere in any way with the bare wire coming through back connections, and should be a safe distance to prevent any danger from grounds. To this iron frame should be securely bolted large slabs of marbleized slate or white marble. Asbestos cloth or other cushioning device should be interposed between the slate and the contact points of the iron frame, so that the slate slabs may be securely fastened without risk of breakage. If slate is used, it should be carefully tested after all holes are drilled, to insure perfect insulation. All instruments to be used on the board should then be connected directly to the slate slabs and not set on independent sub-bases unless absolutely necessary. As before mentioned, all connections on instruments should be made from the back of the board and no wiring exposed from the front. At the same time, all connections and wire should be so located as to be easily accessible for repairs or inspection. Where wires are passed through the floor below the switchboard, the holes should be fitted with a floor insulator of hard rubber made water tight so that the floor beneath the switchboard may be kept perfectly clean, and if any water accumulates, it shall not be able to follow the wire down through the floor.

In addition to the foregoing arrangement of the switchboard, the following plan may be used: Instead of running three wires directly from each generator to a three-hole switch on the switchboard, take the equalizing wire from each machine and run to a common point, using a short bus, or any method of connecting which may be deemed most practical; so that all equalizing wires shall be of equal resistance to this point. Then take the ground main from the generator and run directly to the ground bus. The line main from the generator is then taken directly to the switchboard and connected to a single pole switch. From this switch connections will be made similar to the board already described. This arrangement provides a switchboard in which all wires are of the same polarity, and it insures a very safe method of operating. The only objection to this is that it is impossible to cut out the machine entirely from the switchboard, and it is therefore advisable in using this method to have each generator equipped with a double pole switch attached directly to the generator controlling both lines.

Regarding the grounding of positive or negative wire, a great variety of opinion is expressed by engineers as to the better method; some advising the grounding of positive, and others the neutral wire, the result which it is desired to obtain being a condition which will produce the least electrolytic action at contact points in the ground return, such as bond wires, supplementary, etc.

We have tried to outline in general here the important factors for consideration in an ideal central power station; our desire being more to lead up to a general line of thought or discussion on the matter, and point out some of the most desirable features in relation thereto. If we have accomplished this, our purpose has been fulfilled.

Trusting the matter will meet with your earnest and careful consideration and free discussion, it is very respectfully submitted.

SIR JOHN PENDER AND JAY GOULD.

A WRITER in the Sunday *Recorder* tells the following interesting story about the visit of Sir John Pender to this country in the early eighties.

"There was some talk in financial and other circles at the time of Mr. Pender going into the Western Union directory, and I believe he did go in. Mr. Pender had been away out on the plains, and, the special car in which he traveled having been hauled up at a "siding," the telegraph office of the Western Union Company was entered to get the news. "I was then informed," said Mr. Pender, "of the great victory of our troops in Egypt under Gen. Wolseley. I got news of the success, taking American time as the standard, ahead of the hour when the battle had been fought, and I wired Gen. Wolseley my congratulations to Egypt from the midst of the American wilderness." "The fact," said Mr. Pender, "that, through human agency, that feat was possible of accomplishment, that in my case it had been accomplished, made a deeper impression upon my mind than I can describe to you. It was a miracle of human progress."

The incident naturally suggested the name of Mr. Gould, and to Mr. Pender I put the question, "What is your estimate of Mr. Gould?" The papers had told me that they had met.

"Mr. Gould," said Mr. Pender, "is the ablest, the most sagacious, the most far-seeing man I have ever met."

"Ten minutes after Mr. Pender had spoken these words I saw Mr. Gould walking down Broadway along by Trinity church. Crossing over from the head of Wall street we met near the main entrance of the building. He stopped and I opened the conversation in these words: "Mr. Gould, a few minutes ago I was with the Cable King of the old world, and now I meet the Telegraph King of the new one."

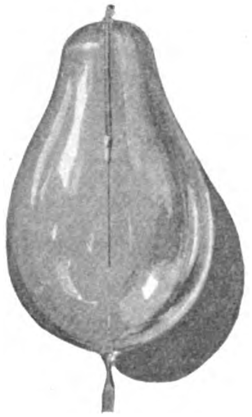
"You mean Mr. Pender," he answered, with the faintest perceptible smile.

"Yes," I replied, "and in the course of an hour's chat with him he spoke about you."

"Mr. Gould became at once interested, and said: "Well, what did he say?" I repeated the words above quoted. He looked in at the tomb of Lawrence of "never give up the ship" fame just inside the church railings. Two o'clock in the afternoon; Broadway was thronged. Looking up suddenly, he saw that fifteen or twenty people had stopped to look at him. His pallid face flushed a little, and he said: "Will you walk down to the office with me?" It was only a few steps away. I then told him about the Wolseley incident, and what Mr. Pender had said of Western Union, which seemed to gratify him very much."

ALTERNATE CURRENTS OF HIGH POTENTIAL AND HIGH FREQUENCY.[1]—I.

BY NIKOLA TESLA.



AT the first outset this investigation was taken up with the view of studying the effects of rapidly changing electrostatic and electromagnetic stresses. It was thought, from theoretical considerations, that some useful observations would be made in following up this line of experiment by means of properly constructed apparatus; but the anticipations were by far surpassed, for a number of unexpected phenomena were noted, and some novel facts brought to light, which have opened up a new and promising field of research. Some of the results obtained are of special interest on account of their direct bearing upon the problem of producing an efficient illuminant.

The phenomena which are due to the changing character of the stresses are exalted when the time rate of change is increased, hence the study of these phenomena is much facilitated by the employment of apparatus adapted especially for the purpose of carrying on such investigations. With this object in view, several types of alternators were constructed, capable of giving currents of frequencies from 5 to 10,000 and even more. Currents of much higher frequencies used in some of these experiments, were obtained by disruptively discharging condensers.

The construction of the alternators offered at first great difficulties. To obtain these frequencies it was necessary to provide several hundred polar projections, which were necessarily small and offered many drawbacks, and this the more, as exceedingly high peripheral speeds had to be resorted to. In some of the first machines both armature and field had polar projections. These machines produced a curious noise, especially when the armature was started from the state of rest, the field being charged. The most efficient machine was found to be one with a drum armature, the iron body of which consisted of very thin wire annealed with special care. It was, of course, desirable to avoid the employment of iron in the armature, and several machines of this kind, with moving or stationary conductors were constructed, but the results obtained were not quite satisfactory, on account of the great mechanical and other difficulties encountered.

The study of the properties of the high frequency currents obtained from these machines is very interesting, as nearly every experiment discloses something new. Two coils traversed by such a current attract or repel each other with a force which, owing to the imperfection of our sense of touch, seems continuous. An observation, scarcely foreseen, is that a piece of iron, surrounded by a coil through which the current is passing appears to be continuously magnetized. This apparent continuity might be ascribed to the deficiency of the sense of touch, but there is evidence that in currents of such high frequencies one of the impulses preponderates over the other. As might be expected, conductors traversed by such currents are rapidly heated, owing to the increase of the resistance, and the heating effects are relatively much greater in the iron.

The hysteresis losses in iron are so great that an iron core, even if finely subdivided, is heated in an incredibly short time. To give an idea, an ordinary iron wire of $\frac{1}{16}$ inch in diameter inserted within a coil having 250 turns, with a current estimated to be five amperes passing through the coil, becomes within two seconds' time so hot as to scorch wood. Beyond a certain frequency, an iron core, no matter how finely subdivided, exercises a dampening effect, and it was easy to find a point at which the impedance of a coil was not affected by the presence of a core consisting of a bundle of very thin well annealed and varnished iron wires.

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[1] A lecture delivered before The Royal Institution of Great Britain, Thursday, February 4, 1892. Author's abstract in Transactions.

Experiments with a telephone, a conductor in a strong magnetic field, or with a condenser or arc, seem to afford certain proof that sounds far above the usually accepted limit of hearing would be perceived if produced with sufficient power.

The arc produced by these currents possesses several interesting features. Usually it emits a note the pitch of which corresponds to twice the frequency of the current, but if the frequency be sufficiently high it becomes noiseless, the limit of audition being determined principally by the linear dimensions of the arc. A curious feature of the arc is its persistency, which is due partly to the inability of the gaseous column to cool and increase considerably in resistance, as in the case with low frequencies, and partly to the tendency of such a high frequency machine to maintain a constant current.

In connection with these machines the condenser affords a particularly interesting study. Striking effects are produced by proper adjustments of capacity and self-induction. It is easy to raise the E. M. F. of the machine to many times the original value by simply adjusting the capacity of a condenser connected in the induced circuit. If the condenser be at some distance from the machine, the difference of potential on the terminals of the latter may be only a small fraction of that on the condenser.

But the most interesting experiences are made when the tension of the currents from the machine is raised by means of an induction coil. In consequence of the enormous rate of change obtainable in the primary current, much higher potential differences are obtained than with coils operated in the usual ways, and, owing to the high frequency, the secondary discharge possesses many striking peculiarities. Both the electrodes behave generally alike, though it appears from some observations that one current impulse preponderates over the other, as before mentioned.

The physiological effects of the high tension discharge are found to be so small that the shock of the coil can be supported without any inconvenience, except perhaps a small burn produced by the discharge upon approaching the hand to one of the terminals. The decidedly smaller physiological effects of these currents are thought to be due either to a different distribution through the body or to the tissues acting as condensers. But in the case of an induction coil with great many turns the harmlessness is principally due to the fact that but little energy is available in the external circuit when the same is closed through the experimenter's body, on account of the great impedance of the coil.

In varying the frequency and strength of the currents through the primary of the coil, the character of the secondary discharge is greatly varied, and no less than five distinct forms are observed:—weak, sensitive thread discharge, a powerful flaming discharge, and three forms of brush or streaming discharges. Each of these possesses certain noteworthy features, but the most interesting to study are the latter. Under certain conditions the streams, which are presumably due to the violent agitation of the air molecules, issue freely from all points of the coil, even through a thick insulation. If there is the smallest air space between the primary and secondary, they will form there and surely injure the coil by slowly warming the insulation. As they form even with ordinary frequencies when the potential is excessive, the air-space must be most carefully avoided.

These high frequency streamers differ in aspect and properties from those produced by a static machine. The wind produced by them is small and should altogether cease if still considerably higher frequencies could be obtained. A peculiarity is that they issue as freely from surfaces as from points. Owing to this, a metallic vane, mounted in one of the terminals of the coil so as to rotate freely, and having one of its sides covered with insulation, is spun rapidly around. Such a vane would not rotate with a steady potential, but with a high-frequency coil it will spin, even if it be entirely covered with insulation, provided the insulation on one side be either thicker or of a higher specific inductive capacity. A Crookes electric radiometer is also spun around when connected to one of the terminals of the coil, but only at very high exhaustion or at ordinary pressures.

There is still another and more striking peculiarity of such a high frequency steamer, namely, it is hot. The heat is easily perceptible with frequencies of about 10,000, even if the potential is not excessively high. The heating effect is, of course, due to the molecular impacts and collisions. Could the frequency and potential be pushed far enough, then a brush could be produced resembling in every particular a flame and giving light and heat, yet without a chemical process taking place. The hot brush, when properly produced, resembles a jet of burning gas escaping under great pressure, and it emits an extraordinary strong smell of ozone. The great ozonizing action is ascribed to the fact that the agitation of the molecules of the air is more violent in such a brush than in the ordinary streamer of a static machine.

But the most powerful brush discharges were produced by employing currents of much higher frequencies than it was possible to obtain by means of the alternators. These currents were obtained by disruptively discharging a condenser and setting up oscillations. In this manner currents of a frequency of several hundred thousand were obtained. Currents of this kind produce striking effects. At these frequencies, the impedance of a copper bar is so great that a potential difference of several hundred volts can be maintained between two points of a short and thick bar, and it is possible to keep an ordinary incandescent lamp burning at full candle power by attaching the terminals of the lamp to two points of the bar no more than a few inches apart. When the frequency is extremely high, nodes are found to exist on such a bar, and it is easy to locate them by means of a lamp.

By converting the high-tension discharges of a low-frequency coil in this manner, it was found practicable to keep a few lamps burning on the ordinary circuit in the laboratory, and by bringing the undulation to a low pitch, it was possible to operate small motors. This plan likewise allows of converting high-tension discharges of one direction into low tension unidirectional currents, by adjusting the circuit so that there are no oscillations. In passing the oscillating discharges through the primary of a specially-constructed coil, it is easy to obtain enormous potential differences with only few turns of the secondary.

Great difficulties were at the beginning experienced in producing a successful coil on this plan. It was found necessary to keep all air, or gaseous matter in general, away from the charged surfaces, and oil immersion was resorted to. The wires used were heavily covered with gutta-percha and wound in oil, or the air was pumped out by means of a Sprengel pump.

The general arrangement was the following: An ordinary induction coil, operated from a low-frequency alternator, was used to charge Leyden jars. The jars were made to discharge over a single or multiple gap through the primary of the second coil. To insure the action of the gap, the arc was blown out by a magnet or air-blast. To adjust the potential in the secondary a small oil condenser was used, or polished brass spheres of different sizes were screwed on the terminals and their distance adjusted.

When the conditions were carefully determined to suit each experiment, magnificent effects were obtained.

Two wires, stretched through the room, each being connected to one of the terminals of the coil, emit streams so powerful that the light from them allows distinguishing the objects in the room; the wires become luminous even if covered with thick and most excellent insulation. When two straight wires, or two concentric circles of wire, are connected to the terminals, and set at the proper distance, a uniform luminous sheet is produced between them. It was possible in this way to cover an area of more than one meter square completely with the streams. By attaching to one terminal a large circle of wire and to the other terminal a small sphere, the streams are focused upon the sphere, produce a strongly lighted spot upon the same, and present the appearance of a luminous cone. A very thin wire glued upon a plate of hard rubber of great thickness, on the opposite side of which is fastened a tinfoil coating, is rendered intensely luminous when the coating is connected to the other terminal of the coil. Such an experiment can be performed also with low frequency currents, but much less satisfactorily.

When the terminals of such a coil, even of a very small one, are separated by a rubber or glass plate, the discharge spreads over the plate in the form of streams, threads, or brilliant sparks, and affords a magnificent display, which cannot be equalled by the largest coil operated in the usual ways. By a simple adjustment it is possible to produce with the coil a succession of brilliant sparks, exactly like with a Holtz machine.

Under certain conditions, when the frequency of the oscillation is very great, white phantom-like streams are seen to break forth from the terminals of the coil. The chief interesting feature about them is, that they stream freely against the outstretched hand or other conducting object without producing any sensation, and the hand may be approached very near to the terminal without a spark being induced to jump. This is due presumably to the fact that a considerable portion of the energy is carried away or dissipated in the streamers, and the difference of potential between the terminal and the hand is diminished.

It is found in such experiments, that the frequency of the vibration and the quickness of succession of the sparks between the knobs affect to a marked degree the appearance of the streams. When the frequency is very low, the air gives way in more or less the same manner as by a steady difference of potential, and the streams consist of distinct threads, generally mingled with thin sparks, which probably correspond to the successive discharges occurring between the knobs. But when the frequency is very high, and the arc of the discharge produces a sound which is loud and smooth (which indicates both that oscillation takes place and that the sparks succeed each other with great rapidity), then the luminous streams formed are perfectly uniform. They are generally of a purplish hue, but when the molecular vibration is increased by raising the potential they assume a white color.

The luminous intensity of the streams increases rapidly when the potential is increased; and with frequencies of only a few hundred thousand, could the coil be made to withstand a sufficiently high potential difference, there is no doubt that the space around a wire could be made to emit a strong light, merely by the agitation of the molecules of the air at ordinary pressure.

Such discharges of very high frequency which render luminous the air at ordinary pressure we have very likely occasion to witness in the aurora borealis. From many of these experiments it seems reasonable to infer that sudden cosmic disturbances, such as eruptions on the sun, set the electrostatic charge of the earth in an extremely rapid vibration, and produce the glow by the violent agitation of the air in the upper and even in the lower strata. It is thought that if the frequency were low, or even more so if the charge were not at all vibrating, the lower, dense strata would break down as in a lightning discharge. Indications of such breaking down have been repeatedly observed, but they can be attributed to the fundamental disturbances, which are few in number, for the superimposed vibration would be so rapid as to not allow a disruptive break.

The study of these discharge phenomena has led to the recognition of some important facts. It was found that gaseous matter must be most carefully excluded from any dielectric which is subjected to great, rapidly-changing electrostatic stresses. Since it is difficult to exclude the gas perfectly when solid insulators are used, it is necessary to resort to liquid dielectrics. When a solid dielectric is used, it matters little how thick and how good it is; if air be present streamers form, which gradually heat the dielectric and impair its insulating power, and the discharge finally breaks through. Under ordinary conditions the best insulators are those which possess the highest specific inductive capacity, but such insulators are not the best to employ when working with these high frequency currents, for in most cases the higher specific inductive capacity is rather a disadvantage. The prime quality of the insulating medium for these currents is continuity. For this reason principally it is necessary to employ liquid insulators, such as oils. If two metal plates, connected to the terminals of the coil, are immersed in oil and set a distance apart, the coil may be kept working for any length of time without a break occurring, or without the oil being warmed, but if air bubbles are introduced, they become luminous; the air molecules, by their impact against the oil, heat it, and after some time cause the insulation to give way. If, instead of the oil, a solid plate of the best dielectric, even several times thicker than the oil intervening between the metal plates, is inserted between the latter, the air having free access to the charged surfaces, the dielectric invariably is warmed and breaks down. The employment of the oil is advisable or necessary even with low frequencies, if the potentials are such that streamers form, but only in such cases, as is evident from the theory of the action. If the potentials are so low that streamers do not form, then it is even disadvantageous to employ oil, for it may, principally by confining the heat, be the cause of the breaking down of the insulation. The exclusion of gaseous matter is not only desirable on account of the safety of the apparatus, but also on account of economy, especially in a condenser, in which considerable waste of power may occur merely owing to the presence of air, if the electric density on the charged surfaces is great.

In the course of these investigations a phenomenon of special scientific interest has been observed. It may be ranked among the brush phenomena, in fact it is a kind of brush which forms at, or near, a single terminal in high vacuum. In a bulb with a conducting electrode, even if the latter be of aluminum, the brush has only a very short existence, but it can be preserved for a considerable length of time in a bulb devoid of any conducting electrode. To observe the phenomenon it is found best to employ a large spherical bulb having in its centre a small bulb supported on a tube sealed to the neck of the former. The large bulb being exhausted to a high degree, and the inside of the small bulb being connected to one of the terminals of the coil, under certain conditions there appears a misty haze around the small bulb, which, after passing through some stages, assumes the form of a brush, generally at right angles to the tube supporting the small bulb. When the brush assumes this form it may be brought to a state of extreme sensitiveness to electrostatic and magnetic influence. The bulb hanging straight down, and all objects being remote from it, the approach of the observer within a few paces will cause the brush to fly to the opposite side, and if he walks around the bulb it will always keep on the opposite side. It may begin to spin around the terminal long before it reaches that sensitive stage. When it begins to turn around, principally, but also before, it is affected by a magnet, and at a certain stage it is susceptible to magnetic influence to an astonishing degree. A small permanent magnet, with its poles at a distance of no more than two centimetres, will affect it visibly at a distance of two metres, slowing down or accelerating the rotation according to how it is held relatively to the brush.

When the bulb hangs with the globe down, the rotation is always clockwise. In the southern hemisphere it would occur in the opposite direction and on the (magnetic) equator the brush should not turn at all. The rotation may be reversed by a magnet kept at some distance. The brush rotates best, seemingly, when it is at right angles to the lines of force of the earth. It very likely rotates, when at its maximum speed, in synchronism with the alternations, say 10,000 times a second. The rotation can be slowed down or accelerated by the approach or receding of the observer, or any conducting body, but it cannot be reversed by putting the bulb in any position. Very curious experiments may be performed with the brush when in its most sensitive state. For instance, the brush resting in one position, the experimenter may, by selecting a proper position, approach the hand at a certain considerable distance to the bulb, and he may cause the brush to pass off by merely stiffening the muscles of the arm, the mere change of configuration of the arm and imperceptible displacement being sufficient to disturb the delicate balance. When it begins to rotate slowly, and the hands are held at a proper distance, it is impossible to make the slightest motion without producing a visible effect upon the brush. A metal plate connected to the other terminal of the coil affects it at a great distance, slowing down the rotation often to one turn a second.

It is hoped that this phenomenon will prove a valuable aid in the investigation of the nature of the forces acting in an electrostatic or magnetic field. If there is any motion which is measurable going on in the space, such a brush would be apt to reveal it. It is, so to speak, a beam of light, frictionless, devoid of inertia. On account of its marvellous sensitiveness to electrostatic or magnetic disturbances it may be the means of sending signals through submarine cables with any speed, and even of transmitting intelligence at a distance without wires.

LETTERS TO THE EDITOR.

THE DRIFTLESS BALLISTIC GALVANOMETER.

In a communication appearing in your issue of Dec. 21, 1892, under the above heading, Messrs. Nalder Bros. & Co. have made the statement with reference to an instrument described by me in an article in The Electrical Engineer, of Nov. 16, that "the whole general plan is a barefaced copy of our ballistic galvanometer described," etc. Language so much more exact than courteous demands equally exact reply. The statement made is utterly and entirely false; inspection of the two illustrations and descriptions can not lead to any other conclusion, Messrs. Nalder Bros. & Co.'s opinion to the contrary notwithstanding. I can only assume from the fact that Messrs. Nalder Bros. & Co. themselves invite such comparison that they have trusted to the almost universal preference of people to accept a statement on faith rather than take the trouble to verify it, since I am sure that they are not so inexperienced in instrument construction as to call two instruments *alike* because each has a base and three leveling screws.

Far from being alarmed by this "deadly parallel," nothing would afford me greater satisfaction than to have these two illustrations printed side by side, as Messrs. Nalder Bros. & Co. suggest. Having some faith in my own performances I find that I am usually only too willing to make comparisons and I shall certainly not refuse the present opportunity so kindly offered.

Comparing the two engravings, then, in the first place, each instrument has a round base, two coils, a metal case and a system consisting of four bell magnets. In the Nalder instrument the case is exactly the same as the case shown on page 287 of Ayrton's *Practical Electricity* as applied to a Thomson galvanometer even to the symmetrical placing of the two binding posts which pass through the case to make contact with the coil terminals. This same case may be seen again on page 18 of Paterson & Cooper's 1890 catalogue of "Electrical Measuring Instruments;" also in Elliott Bros.' catalogues for ten years back on the "round brass pattern" of Thomson galvanometer. This case, as made by Nalder Bros., has to be bodily lifted up and off in order that the coils may be gotten at; it is also necessary to unscrew both binding posts each time the system is to be reached. As the case carries part of the controlling system the control of the needle will be altered each time the case is disturbed. It is, hence, impossible to adjust nicely the instrument, since if the case is off we cannot get a suitable "control," and if on, we cannot get to the system.

The case of my instrument is made in two halves, the front half swinging forward so as to expose the coils; but one binding post must be taken out to accomplish this and the "control" is not altered in the least. The coils are mounted, in my instrument, on two corrugated rubber pillars instead of four plain ones; taking account of the corrugation the insulation resistance of my instrument is four times that of the Nalder. The coil frames of the Nalder are made differently from mine; though they swing away from one another they are not interchangeable as mine are. Also in my instrument it is possible to connect the two coils in any desired way either in series, multiple or differentially; or either coil may be used singly. Thus a 1,000 ohm galvanometer may be converted, besides, into a 500 or a 250 ohm instrument or a 250 ohm differential. In the Nalder the coils can only be used in series.

The magnetic system is very like the Nalder system; it is, however, one of the usual forms of Thomson system with bell magnets substituted for flat ones; moreover it is exactly like several made by Queen & Co., several years since for the United States Government, save that in the latter a sphere was used instead of two bell magnets in the centre and that the improved "non-drifting" device was not attached. If there is any creditable originality in the use of four bell magnets related to one another as I have them in my instument I cheerfully yield it all to Messrs. Nalder Bros. & Co. with an apology for ever having unconsciously endeavored to retain it; had I been aware that they considered their reputation to rest upon so slender a basis I should certainly have been more particular about these small points.

To continue and to be brief: The little magnet upon the case and the "tail magnet" seen upon the Nalder galvanometer are *not* seen in mine. I gave them a trial and gave them up because they would not either theoretically or practically perform their function. This fact might tend to render one charge of giving credit to any one before first ascertaining their wishes, since, if I remember aright, Messrs. Nalder Bros. & Co. kindly ascribed this improvement (?) to Dr. Mullineux Walmsley who, however, repudiated it a few weeks later in a letter to the London *Electrician*, April 17th, 1891, page 740. The control in my galvanometer is effected by an entirely different plan used, I believe, for the first time; by means of this plan a period of 1½ minutes can be easily attained without the slightest "drift." This is really the one great noteworthy feature of the instrument. The various other important differences between my instrument and the Nalder, such as the fact that the former has a divided torsion head where the latter has not; that the coils of the former are graded while those of the latter are not, etc., have so little to do with the general plan that it is not necessary to speak of them in detail.

The gratuitous slur upon the firm with which I am connected is hardly worth referring to; this manner of manifesting a loss of temper seems to be an attribute of some men as well as of children. I can imagine, too, how painful it must be to some people to bring themselves to a realization of the fact that anyone else knows anything. Some allowance must be made, also, for the natural disappointment of our British friends that the infant enterprise of American instrument making has been learning to do some pretty vigorous creeping during the last year.

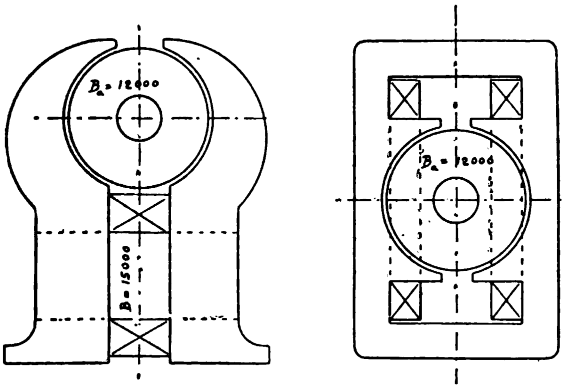
PHILADELPHIA, PA.

ELMER G. WILLYOUNG.

THE DESIGN OF THE LUNDELL MOTOR.

MY attention having been called to a letter published in THE ENGINEER of Dec. 28, 1892, headed: "The Design of the Lundell Motor," I deem it my duty to respond.

The writer of said article, a Mr. Dahl, whatever his aim may be, is evidently not aware of the fact that the mere length of wire per turn in the field coil of a dynamo or motor is not always the most important consideration. Without going into any elaborate demonstrations I will simply, for the sake of argument, call attention to two different types of motors, as shown in Figs. 1 and 2. The machine shown in Fig. 1. would be the best type of the two, according to the idea of Mr. Dahl. The induction through the field coil of this machine can be pushed as high as 15,000 lines per sq. cm. and the length of wire per turn would be quite small indeed. In the type shown in Fig. 2 the field coil surrounds part of the armature as well as a considerable air-space at both ends. With an induction of 6,000 lines per sq. cm. across the air-gap it would hardly be possible that the mean induction through the field coil could be more than 5,000 lines per sq. cm.



FIGS. 1 AND 2.

From this we see that the areas enclosed by the field coils of these two machines are as 1 to 3; or, in other words, that the length of wire per turn in the machine Fig. 2 is $\sqrt{3} = 1.73$ times that of the machine Fig. 1 (provided the coils were made of the same shape). It is unneccessary for me to show the reason why the greater length of wire per turn in machine Fig. 2 is more than compensated for by other more important gains. All electricians know this type too well and will readily acknowledge its superiority. Thus it will easily be understood that the length of wire per turn in the field coils of a dynamo or motor does not always play such an important rôle as Mr. Dahl seems to imagine.

In the motor designed by me and shown in Fig. 3, the length of wire per turn in the field coil is practically the same as in the machine Fig. 2. The construction is, however, simplified, and the resistance of the magnetic circuit made so small that the *number* of turns in field coil are reduced to a minimum, thereby making the watts expended in field less than in any other motor of the same capacity and speed.

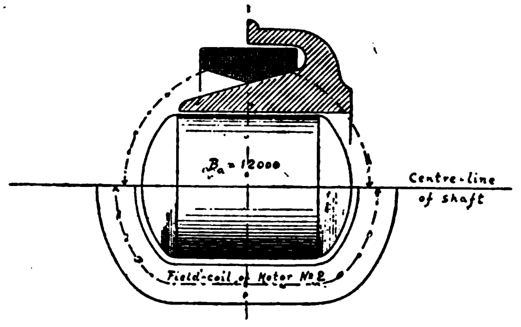


FIG. 3.

If it be true that Mr. Dahl, in 1888, constructed a motor of the type he says he had to abandon, I wish to express it as my view that the motor must have been constructed without proper knowledge of the art.

A poor design will spoil anything.

NEW YORK, Dec. 30, 1892.

ROBT. LUNDELL.

SOCIETY AND CLUB NOTES.

PREPARATIONS FOR THE ST. LOUIS ELECTRIC LIGHT CONVENTION.

SECRETARY G. F. PORTER is busily engaged making plans for the Convention of the National Electric Light Association, at the Southern Hotel, St. Louis, the last week in February. Several valuable papers have been secured including ones of greatest interest by Messrs. Blaxter, of Pittsburgh, and Sterling, of Denver; while the greatest interest is manifested by members and leading citizens in the lecture that Mr. Nikola Tesla has kindly consented to deliver, accompanied by experiments, on his high-frequency work in light and power. Mr. Porter hopes to be able to announce the full programme in a few days, after a consultation with President Ayer.

With regard to the Electric Club recently organized at St. Louis, primarily to receive and entertain the Association it may be mentioned that they have perfected their organization, received their charter and fitted up one or two very delightfully located rooms in the Equitable Building, Sixth and Locust streets, on the second floor. One room has been furnished for a general lounging, reading and reception room, in a very elegant manner, and will compare favorably with anything of the kind in the country. The room is 60 by 40 on the corner, so that it is exceptionally well ventilated and lighted. The room is steam-heated and lighted with incandescent lights. The second room will be furnished in a short time as a billiard and smoking room.

At the opening of the new year, this club has completed its organization with 90 members, which number will undoubtedly very materially increase in the near future. The electrical men of St. Louis will have no occasion to feel ashamed of the quarters to which they can introduce their colleagues from abroad during the Convention of the National Electric Light Association next February.

THE NEW YORK ELECTRICAL SOCIETY.

THE 150th meeting of the Society will take place on Jan. 11, 1893, at 8 p. m., at Columbia College, Madison avenue and Forty-ninth street.

MR. AUGUSTUS NOLL, General Superintendent of the New York Electric Equipment Company will give "A PRACTICAL TALK ON THE INSTALLATION OF ISOLATED ELECTRIC LIGHTING PLANTS," of which the following is a brief synopsis.

1. Determination of Size of Unit for Dynamo and Engine. 2. The Location of Dynamo and Engine. 3. The Construction and

Connection of Switchboards. 4. Different Systems of Wiring: (a) Feeder System: (b) Feeder and Main to Central Points; (c) The Crib System. 5. General Remarks on Wiring, Location of Lamps, Switches, etc. 6. Special Installations: Theatres, Breweries, Public Institutions, etc.

The lecturer will also illustrate the method of calculating the size of conductors required, by working out an actual example.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 73d meeting will be held at the headquarters of the institute, 12 West 31st street, Tuesday, January 17th, at 8 p. m. The paper to be presented is entitled: "Electrical Recording Meters," by Mr. Caryl D. Haskins, manager of the meter department, General Electric Co., Boston, Mass. Beginning with this meeting, the new arrangement for the publication of papers goes into effect, by which advance copies usually printed for the use of those in attendance will be made the regular mail edition of the transactions, and it is the intention that they shall reach the membership on or before the date of the meeting. Owing to the frequent delay of printed matter in the New York Post Office, those who may wish to participate in the discussion are advised to have a copy mailed at first class rate, which will be done upon application to the secretary. Members attending are requested to bring their copies with them. Gentlemen who are not identified with the institute are cordially invited to attend. The council will meet in the secretary's office at 5 o'clock.

THE PROPOSED STREET RAILWAY SUPPLY ASSOCIATION.

As chairman of the meeting held during the Cleveland, Ohio, convention, Mr. J. E. Lockwood has issued a circular giving the result of the negotiations that went on at that time, when it was decided that a supply men's association had not been shown to be necessary.

THE MAGNETIC CLUB.

The above club will hold its annual business meeting at Room 60, No. 195 Broadway, on Thursday, January 12, at 5.30 p. m., to elect officers and four members of the Governing Committee.

THE NEW LONDON, CONN., ELECTRIC CLUB.

The New London Electric Club at its last meeting listened to a paper on "Volta and His Contributions to Electrical Science." After a short discussion E. W. Burch, who has served the club faithfully as its president ever since its organization, tendered his resignation. J. R. Troland, the treasurer, was immediately promoted to the presidency, and W. D. Harris was elected to fill the vacancy.

BUFFALO ELECTRICAL SOCIETY.

On Monday, Dec. 19, Mr. Frank Kitton read a paper before this society on "Magnetism," which was listened to by a largely attended meeting. The lecturer illustrated his remarks by numerous experiments. After the discussion which followed, seven new members were elected. The librarian reported the addition to the library of ten new books.

ELECTRICAL SECTION BROOKLYN INSTITUTE.

On January 13, Mr. Albon Man is to lecture before the section on the interesting subject: "What is Electricity: Is it Force or Only Matter?" This should provoke a lively discussion. On January 20, Mr. E. H. Lyon will lecture on "The Long Distance Telephone," with the help of lantern photographs and a collection of apparatus. During the evening a band playing in Chicago will be heard in the hall, by means of the telephone.

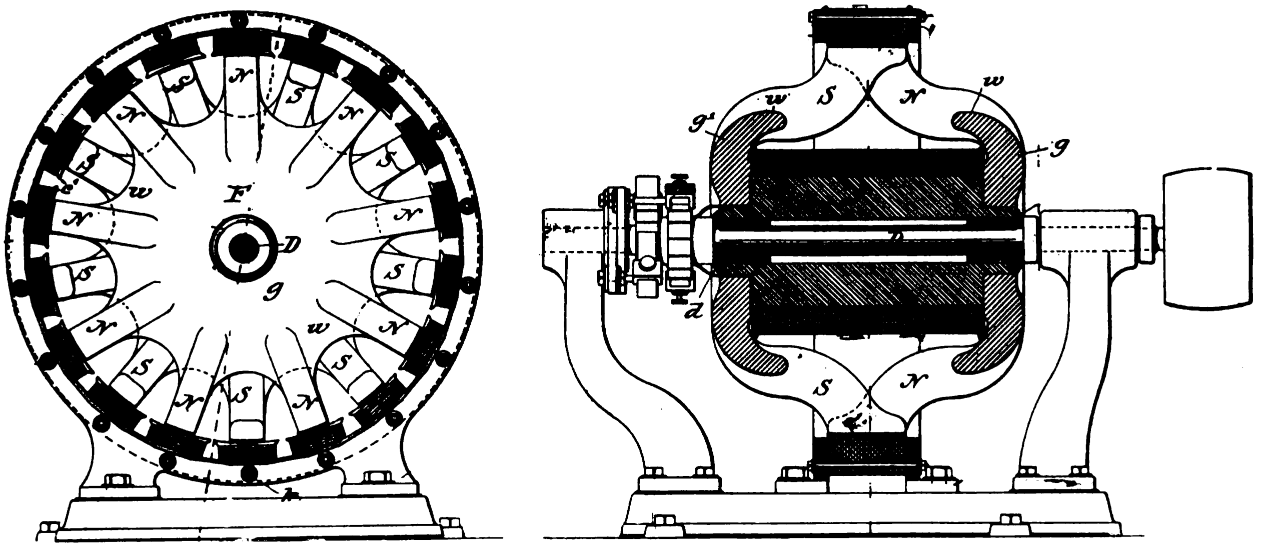
CHICAGO ELECTRIC CLUB.

Resolutions of regret and condolence have been adopted by the Chicago Electric Club, touching the recent death of two of its members—George H. Meeker and M. M. M. Slattery.

PATENT NOTES.

WOOD'S ALTERNATING CURRENT DYNAMO.

With the object of avoiding losses due to the leakage of magnetic lines across the poles of the field magnets and from arm to arm through the armature core in alternate current machines, Mr. James J. Wood, of Fort Wayne, Ind., has recently designed a machine which is described in a patent just issued to him. The machine, which is shown in two views in the accompanying engravings, has polar arms which instead of being laid backwards close against the exterior of the exciting coil, are turned outwardly away therefrom at the middle, and terminate in outwardly radiating polar ends. The armature core is reduced from the entire width of the field magnet to a width of approximately only one-quarter, and the polar ends or faces of the arms N S are made of the same restricted width as the armature core. In this manner the lines of force are confined and concentrated, being forced to pass from the arms N N to the arms S S by entering the armature core, and consequently passing through and cutting the armature coils, so that very nearly all of the lines of force are made effective in the generation of electric potential.



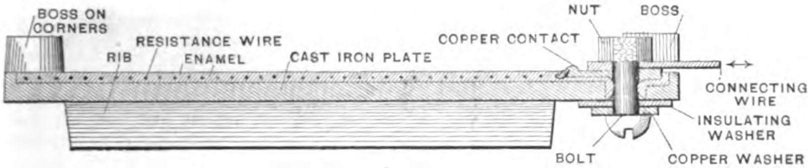
Figs. 1 and 2.—The Wood Alternating Current Dynamo.

The field magnet is further strengthened by constructing it with the discs g g', which are turned inwardly or toward the medial plane of the field magnet, so that these discs are cupped, as shown in Fig. 2, so that they partly inclose the end portions of the exciting coil or coils. The cupping of the discs is effected by the formation of webs w w between the successive arms N N on one disc and S S on the other, these webs being turned inwardly following the direction of the arms, and thereby constituting the cupped portions of the discs, and being also formed with their outlines joining the arms by easy curves so as to distribute the lines of magnetic force to the arms. The inductive effect of the coil sets up lines of magnetic force extending longitudinally through the core f, and radially through the discs g g', and by the cupping of these discs to partly embrace the ends of the coils, the exterior portion of the coil is made effective to add to the magnetization of the polar arms by setting up lines of magnetic force in the cupped portions of the discs, which lines are distributed to the respective arms. The field magnet is thus made stronger than it would be without the discs, and without the cupping of the discs.

THE CARPENTER ENAMEL RHEOSTATS.

The unique properties possessed by the enamel rheostats made by the Carpenter Enamel Rheostat Company, of Bridgeport, Conn., have from the very beginning claimed the attention of electrical engineers, with the result that the various demands made upon the company have led it to undertake the systematic manufacture of a large range and variety of rheostats for all kinds of electrical circuits and work.

The principle of the Carpenter rheostat is the conduction and dissipation of heat by holding a resistance wire in intimate mechanical contact with a supporting plate so that the heat generated in the resistance wire, by the passage of a current, is rapidly conducted to the plate, which becomes the radiating surface. This is accomplished by the use of enamel, which attaches the wire to, but insulates it from, the radiating surface plate, and which also completely surrounds the wire and protects it from chemical action. In this way the capacity of a resistance wire for current is greatly increased. In practice it is found that a wire that will carry a certain current when exposed to the air, will carry ten times that amount of current safely in this rheostat. On this principle, since the cross section of the conductor can be greatly reduced, it follows that its length can be also proportionately shortened for any required resistance, and no consideration of mechanical strength of the wire enters into this construction since it is so perfectly protected and supported on all sides. For example: A No. 20 B & S German silver wire will, in this rheostat, will carry 25 amperes and 80 feet of the wire coiled upon the surface of a plate 10 x 10 inches, will absorb and dissipate five kilowatts of energy in starting a five kilowatt motor of 220 volts under full load.



SECTION OF STANDARD RHEOSTAT PLATE

FIG. 1

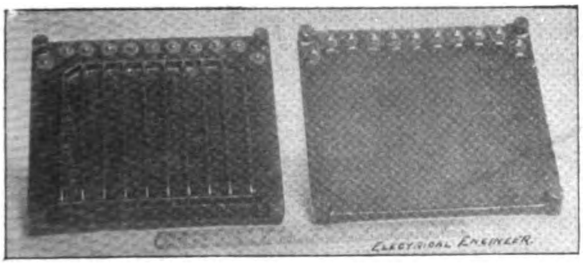


FIG. 2.

To increase the radiating surface, the back of the disc is provided with ribs for extending its radiating surface. The plates will dissipate continuously eight watts per square inch of one surface, *i. e.*, a 10 x 10-inch plate or 100 square inches, will dissipate 800 watts. The temperature of the plate dissipating energy at this rate is entirely safe, as it will not char wood or similar materials when operating under this condition.

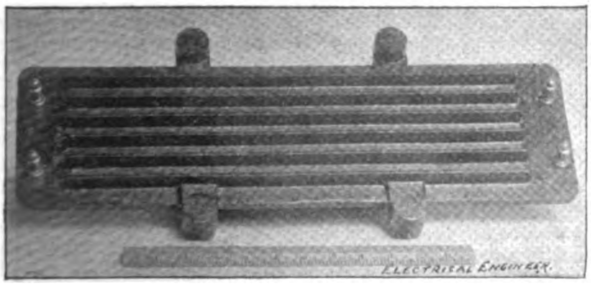


FIG. 3.

These plates will carry for a few seconds when used as a motor starting rheostat, and for similar purposes, a current two and a half times as large as that for which they are rated for continuous service; that is, they will safely dissipate for, say, 15 seconds, six and a quarter times as many watts as they are rated for in continuous duty.

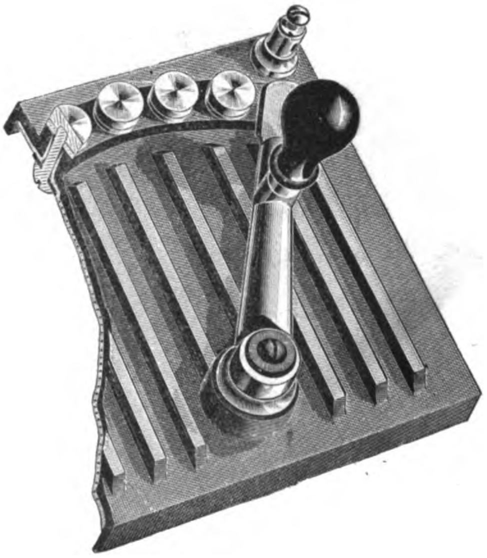


FIG. 4.

For convenience in rapidly supplying the demands of concerns preferring to furnish their own regulating switches, "Standard Plates" for four sizes of motor starting rheostats are always carried in stock. These plates have bosses or lugs at the corners for convenience in attaching to a switch, and are provided with connecting bolts, insulators, etc., at the connecting points of the resistance, as shown in Figs. 1 and 2. The resistance of these standard plates is such that sufficient current will pass when the armature is at rest to give slightly more than the full torque of the armature at full load. They will carry for 15 seconds the full rated current of motor, *i. e.*, a 5-kilowatt, 220-volt motor plate will stand 20 amperes on all steps for 15 seconds. Plates subjected to a certain current continuously must be of such size as to stand for 15 seconds a current two and a half times as much. That is, for continuous service the plates are guaranteed for only 40 per cent. of their rating for 15 seconds. The one and two kilowatt sizes have equal steps and same size wire throughout, except the last two steps next to short circuit, but the three and five kilowatt sizes have graduated or tapered steps, several different sizes of wire being used in their construction, so the last few steps will stand more current for a longer time. These standard plates are built for 220 and 500 volts, but are made also for 110 volts.

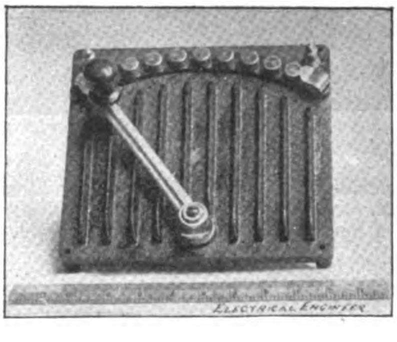


FIG. 5.

The plates are provided at each contact with small brass bolts, nuts and copper washers ready for receiving the wires. In addition to motor starting plates, several other plates are made with resistance to order where the resistance does not exceed 50 ohms, and not less than three ohms. Plates for low resistance and high ampere capacity are made with four wires in multiple in one section, and two sections on one plate separate from each other. This plate is shown in Fig. 3. These sections may be connected in multiple or series as desired.

Fig. 4 shows the principle of the Standard Carpenter Rheostat.

It will be noticed that the same iron plate which carries the switch contacts and lever has the coating of enamel on its under side, with the wires embedded in the enamel, so that the rheostat occupies an extremely small space; no more than the switch parts alone of other rheostats, without the coils. The fire-proof and water-proof qualities will be evident from the illustration. Also its compactness, mechanical strength and simplicity.

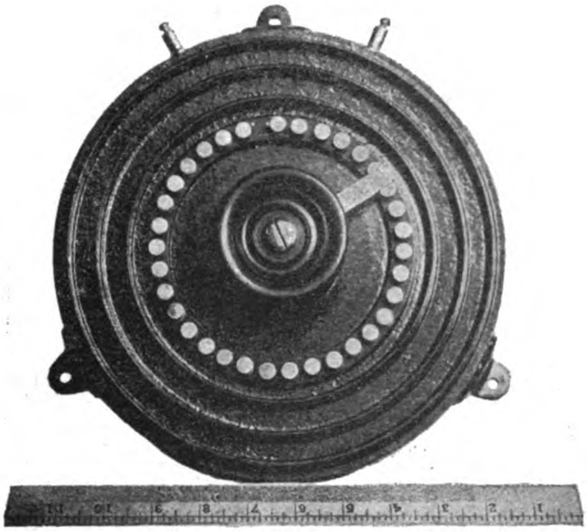


FIG. 6.

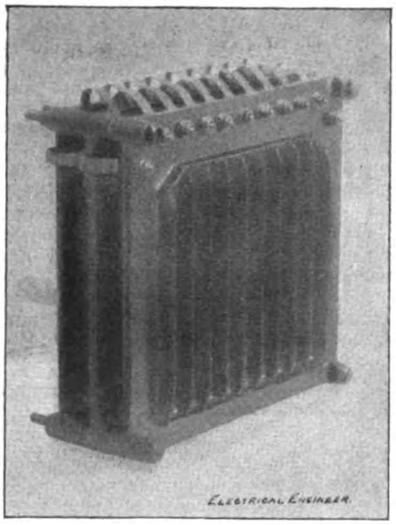


FIG. 7.

Four sizes of motor starters, as shown in Fig. 5, are built. They have the same resistance and current capacity as standard plates for the same size motor.

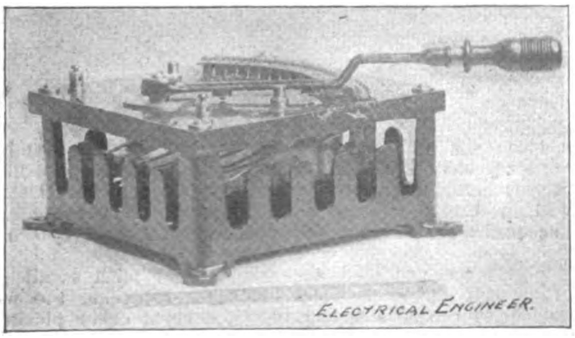


FIG. 9.

Field rheostats are made disc shaped with contacts arranged in a complete circle, as shown by Fig. 6. They are made in four sizes, depending upon the size of machine with which they are intended to be used.

To make a single plate large enough for use in starting a motor larger than 5 kilowatts would make it necessary to have a surface so large as to be objectionable. To avoid this difficulty a number of plates are used either connected in parallel or series, and separated by sufficient space to admit of proper ventilation, connection to the switch being made the same as in the case of standard plates. Fig. 7 shows a 15 kilowatt starting rheostat without switch, made up of three 5 K. W. Standard plates and having their steps connected in multiple. For sizes larger than 15 kilowatt another arrangement has been adopted which consists in using several plates bolted together, mounted in a frame and connected in series, as shown in Fig. 8. Each plate has eight wires arranged into sets, having four wires each. In this way the eight wires may be connected in parallel, or the two sets in series, each set having four wires, in parallel. Thus either 10 or 20 steps may be had with 10 plates, the resistance varying in the ratio of 1 to 4.

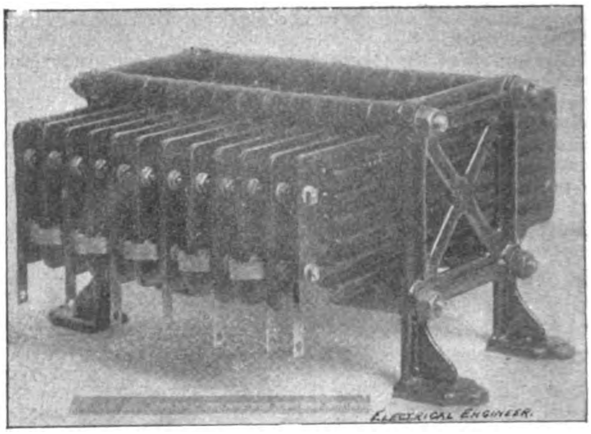


FIG. 8.

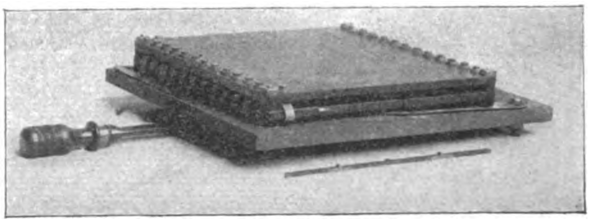


FIG. 10.

Large motor starters are composed of several plates arranged in the same manner as shown in Figs. 7 and 8, but are provided with knife-blade switches similar to that shown in Fig. 9.

Theatre dimmers are made up of plates, the size of which varies with the capacity desired. Several plates are used with their corresponding steps connected in multiple. The plates are bolted to the back of a rheostat switch of the knife-blade pattern, as shown in Fig. 10. The plates with switch are mounted in a ventilated iron box, or provided with angle irons as may be desired. The plates are made with graduated or tapered steps so that the lights will dim gradually, and the total resistance is such that current through lamps is reduced to one-fourth that of full candle power when all resistance is in. The total resistance in the rheostat to accomplish this should be about five times the resistance of the lamps when at full candle power.

Feeder equalizers are made in the same manner as large motor starting rheostats and theatre dimmers.

Arc lamp resistances are made in four sizes, and rated for continuous duty, the prices depending upon the size and capacity of the plate. They are mounted on a pedestal as shown in Fig. 11.

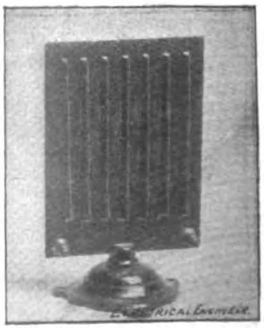


FIG. 11.

Besides its absolutely fire-proof qualities, the Carpenter enamel rheostat possesses the advantage that the resistance wires cannot deteriorate from oxidization, electrolysis, etc. Again, it is compact, requiring less than five per cent. of the cubic space required by the ordinary coiled wire rheostat of the same capacity.

This form of rheostat is cheap, for a certain resistance and carrying capacity can be obtained by the use of a wire whose cross-section and length will both be but one-tenth of that required for a wire used in the air. That is, the total weight of wire, and hence the cost of the same, will be but one per cent. of that usually required.

Finally the rheostat, is unaffected by heat, cold, acids, alkalies, oils and other chemicals, and for this reason is especially adapted for use n mines, breweries, marine vessels, etc., where chemical action rapidly destroys ordinary insulations.

It may be added that Mr. C. D. Shain, of 136 Liberty street, is the selling agent for these rheostats. He will doubtless be glad to furnish further information in regard to the product of the company.

GILBERT'S "DE MAGNETE."

In a letter addressed to the London *Electrician* Prof. Sylvanus P. Thompson doubts the possibility of Mr. P. F. Mottelay having any connection with the forthcoming translation of Gilbert's "De Magnete," to be issued from the press of Messrs. John Wiley & Sons, of this city, and characterizes this publication as an underhand attempt on the part of that firm to forestall the promised translation under the auspices of the Gilbert Club, formed for that purpose some years ago. The reputation for honesty and fair dealing enjoyed by Messrs. Wiley & Sons is such as to render harmless any aspersions such as those cast by Prof. Thompson, who, we are certain, would not have allowed himself to be carried away as he has been, had he been in possession of the facts in the case.

But it seems opportune, nevertheless, to record the fact that long before Mr. Mottelay had begun the actual work of translation, and before the question of a publisher had been considered at all, he laid before us his plan and solicited, and obtained, such aid as we were able to afford him in the prosecution of his work. We also happen to know that not until it was entirely completed was the translation submitted to Messrs. Wiley & Son, so that the charge of a deliberate attempt on the part of that firm to forestall the work of the Gilbert Club is absolutely groundless. We think that the greatest praise is due this American publishing house for its public spirit in bringing out the translation, and we trust the demand will in some measure reward them. Mr. Mottelay's annotated version is intensely interesting, and the advance proof-sheets which we have seen during the past week give promise of a beautiful and valuable volume.

McKINLEY PROTECTION FOR MOTOR-MEN.

Governor McKinley in his annual message to the Ohio State Legislature recommends among other things that the legislature pass an act requiring all street cars to be vestibuled for the protection of motor-men, drivers, etc. He also suggests the street railway companies be required to report all accidents to the railroad commissioners, just as steam railroads have to do.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED DECEMBER 27, 1892.

Accumulators:—

Secondary Battery, N. Wladimiroff, St. Petersburg, Russia, 488,726. Filed July 7, 1892.

Claim 1 follows:

In a secondary battery, electrodes whose opposite faces are of like chemical character or nature but unlike polarity and provided with a spiral-face groove

Alarms and Signals:—

Electric Annunciator, J. H. Bates, Hoboken, N. J., 488,536. Filed June 27, 1892.

Claim 1 follows:

In an electric annunciator, the combination with a frame or base, of an electromagnet, an indicator normally out of view, and an armature for the magnet, independent of the indicator, but jointed to the indicator substantially as shown and described whereby the armature is adapted to positively actuate the indicator.

Electrically Repeating Signal, S. D. Field, Yonkers, N. Y., 488,550. Filed Mar. 5, 1892.

The essential feature consists in originating vibration at a central point and establishing communication between several distant points by damping at one distant point the vibrations developed at the central point, thus causing an intensified reproduction of the vibration at another distant point.

Electric Annunciator, A. B. Lyman, Cleveland, Ohio, 488,567. Filed Oct. 26, 1891.

Employs a pair of magnets and push-buttons connected in multiple arc with a vibrating armature common to both magnets and forming a part of each circuit, and an additional battery and push-button connected directly with one of the magnets.

District Signal Box, C. E. Scribner, Chicago, Ill., 488,579. Filed July 3, 1888.

Provides an answer-back attachment upon district signal boxes operated by a moderate increase of battery current.

Thermostatic Indicator and Adjuster, E. C. C. Krogh, Monmouth, Ill., 488,611. Filed Sept. 2, 1892.

Electric Railway Signal, F. P. Schlosser, Birmingham, Ala., 488,615. Filed June 31, 1892.

A device by means of which the engineman of one train is notified, by means of electrical devices located upon his train, of the approach of a second train.

Push-Button and Thermostat. E. L. Ashley and W. H. Camp, Waterbury, Conn., 488,645. Filed May 25, 1892.

A push-button having a metal shell and a fusible insulation by means of which a supplementary contact is normally held away from said shell.

Watchman's Time Recorder, W. L. Bundy, Binghampton, N. Y., 488,687. Filed Oct. 19, 1891.

Distribution:—

System of Electric Distribution, C. J. Van Depoele, Lynn, Mass., 488,928. Filed June 27, 1889.

Relates to a system of distributing electric currents by means of which a plurality of circuits can be supplied with current of the desired potential from a generator giving currents of a potential above that which is required.

Lamps and Appurtenances:—

Electric Arc Lamp, E. Thomson, New Britain, Conn., 488,585. Filed July 2 1888.

Has for its object to secure by mechanical means, without the use of clock work or retarding mechanism, a self-regulating feed for the carbon rod.

Incandescent Electric Lamp, F. H. Prentiss, New York, 488,635. Filed April 4, 1892.

Employs a section of easily fusible glass below the metal cap for the purpose of facilitating the repairing of broken filaments

Incandescent Lamp, F. H. Prentiss, New York, 488,636. Filed April 27. 1892.

Employs a cap composed of two parts, one permanently fastened to the glass bulb and easily attachable to the other.

Duplex Arc Lamp, H. M. Odell, Detroit, Mich., 488,696. Filed March 28, 1892.

Relates to special mechanism for transferring the current from the first to the second set of carbons, and from both when the second is consumed.

Regulating Socket for Incandescent Electric Lamps, E. E. Ries, Baltimore, Md., 488,835. Filed July 6, 1891.

A self-inductive socket for alternating current lamps.

Device for Raising or Lowering Electric Lamps, W. Doran, Skowhegan, Me., 488,878. Filed Dec. 4, 1890.

Coupling for Light Fixtures, J. A. O'Neill, Boston, Mass., 488,916. Filed July 28, 1892.

Regulating Socket for Incandescent Electric Lamps, E. E. Ries, Baltimore Md., 488,951. Filed July 6, 1881.

Claim 1 follows:

A regulating socket for incandescent electric lamps, etc., provided with a self-inductive conductor within the socket, in the filament circuit, and means for varying the degree of self induction of said conductor.

Metal Working:—

Electrical Soldering Iron. C. L. Coffin, Detroit, Mich., 488,871. Filed July 20, 1891,

Electrically Heated Soldering Tool, C. L. Coffin, Detroit, Mich., 488,872 Filed June 11, 1892.

Miscellaneous:—

Electrolytic Apparatus, T. Craney, Bay City, Mich., 488,708. Filed Apr 1892

Electric Cigar Lighter, E T. Gutberlet and W. R. Izard, St. Louis, Mo. 488,889. Filed June 27, 1892.

Railways and Appliances:—

Trolley Catcher, W. L. Browne, Worcester, Mass., 488,706. Filed July 8, 1892.

Provides means of automatically notifying the motor-man when the trolley leaves the wire.

Closed Conduit for Electric Railways, F. Mansfield, New York, 488,738. Filed Oct. 1, 1891.

Employs a swinging hood provided with interior brackets and an insulated arm secured to the brackets with one end projecting therefrom and provided with a contact plate.

Trolley Wheel, L. J. Hirt, Arlington, Mass., 488,811. Filed July 28, 1892.

A wheel having the walls of the groove made thin near the bottom and reinforced by ribs, so that side wear will become visible from without while the wheel is still effective.

Electric Railway Trolley, C. J. Van Depoele, Lynn, Mass., 488,929. Filed Jan. 31, 1890.

Claim 1 follows:

In an electric railway, the combination with a suspended conductor having a grounded return, of a vehicle having a contact carrying rod or arm extending to the underside of the suspended conductor, and an insulated operating device for the said contact rod or arm.

Electric Locomotive, C. J. Van Depoele, Lynn, Mass., 488,930. Filed Apr. 1 1891.

Claim 1 follows:

An electric locomotive having a driving axle or axles, driving wheels, the hubs of which are rigidly attached to said axle or axles, and radial springs fixedly connected to said hubs and loosely engaging slots in the peripheries of the said driving wheels.

Switches and Cut-Outs:—

Railroad Switch Signal, F. Harris, Guildhall, Vermont, 488,654. Filed Aug. 26, 1892.

An electric device for steam railways by means of which an alarm will be sounded when the switch is open.

Electrical Switch, C. H. Pattison, Boston, Mass., 488 740. Filed Aug. 8, 1892

An electric switch having a universal joint at its fixed point and a number of sets of contacts arranged radially about that point.

Non-Sparking Electric Switch, G. E. Painter, Baltimore, Md., 488,899. Filed Mar. 11, 1892.

Telegraph:—

Electrical Circuit for Telegraph Apparatus, F. W. Jones, New York, 488,940. Filed Aug. 12, 1892.

Contemplates an arrangement of the main and local circuits such that one may repeat in the other, and that the resistance of the circuits will remain substantially uniform.

Telephones and Apparatus:—

Electric Telephonic Switch and System, T. B. Sloper, Devizes, England 488,666. Filed May 18, 1892

An intercommunication system of telephonic switches by means of which any two lines including any number of instruments may be connected directly without an intermediate station.

FREE ADMISSION FOR ELECTRIC SUPPLIES IN THE WEST INDIES.

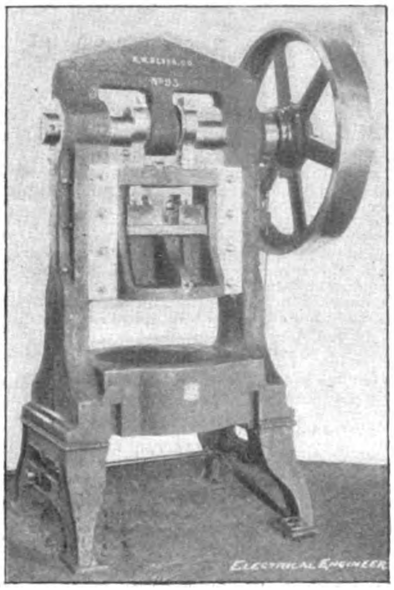
The islands of Trinidad and Tobago will admit free of duty for five years, from January 1, 1893, steam engines, gas engines, boilers, pipes, dynamos, lamps, wires, etc.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE BLISS NO. 95 ARMATURE-CUTTING PRESS.

THE cut shown herewith illustrates a press for blanking out large armature discs as recently built by the E. W. Bliss Co., Limited, 143 Plymouth street, Brooklyn, for the Edison General Electric Company, the Thomson-Houston Electric Company, the Curtis Electric Company and a number of other concerns.



THE BLISS NO. 95 ARMATURE-CUTTING PRESS.

The construction of this press embodies a number of special features which have not heretofore been used in connection with presses of this class.

In order to give a firm support and accurate guidance to the large and delicate dies, the ordinary centre gib has been abandoned and the ways of the slide have been spread apart so as to be as wide as the frame itself. These ways have also been considerably lengthened, adding much to the solidity and accuracy of the machine.

For adjusting the slide, the Stiles eccentric adjustment is used, which enables the operator to quickly raise and lower the slide to the exact point desired without any danger of getting it out of alignment. The pressure with this adjustment is always on solid metal instead of screw threads.

As regularly made, this machine has 32 inches between uprights, and the bed is furnished with a 24 inch round opening, but it is sometimes also made with 40 inches between the uprights and with a 30-inch hole. The weight is approximately 9,400 pounds.

HARRISBURG IDE AND IDEAL ENGINES.

MESSRS. W. R. FLEMING & CO., whose offices are in the *Mail and Express* building, New York City, and who are contractors for steam power plants for electric light and railway service, representing also the Harrisburg "Ide" and "Ideal" engines, have contracted for over 2,500 h. p. of engines during the past 30 days among which are the following plants:—A 1,000 h. p. plant for electric railway service at New Britain, Conn., for which they are building two 500 h. p. tandem compound special railway engines of the "Ideal" self-oiling type; two simple Ideal engines for electric railway service for the Second Avenue Surface Railroad in New York City. These engines are arranged for direct connected multipolar dynamos similar to the four-unit plant now being installed in the new *Mail & Express* Building.

They are now getting ready for export two tandem compound "Ideals" of 225 h. p. each to be shipped to Porto Rico, West Indies. The new Y. M. C. A. Building at Hartford, Conn., are putting in simple engines of the same type for use in lighting their building in connection with the apparatus of the Edison Company.

The Hotel Beresford is being equipped with the same engines, and one has just been shipped to Rochester for the Rochester Car Wheel Works.

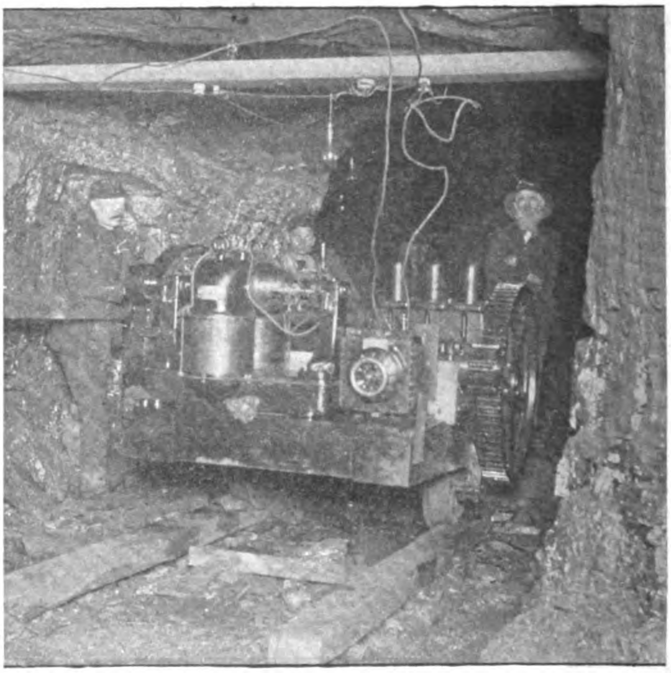
Two standard "Ideal" engines of 175 h. p. each have just been ordered by the United States Government for service in dredging work at Portland, Ore.

ELECTRIC MINE PUMPING AT DURYEA, PA.

AN excellent example of the manner in which electricity is displacing steam in the mining industry is given by the recent installation in the William H. colliery of the Connell Coal Company, located in Duryea, Pa. This colliery is considered one of the most important mines in its district, the average daily output being about 1,200 tons. Many improvements have been made in the plant which will enable the mine to turn out from 1,400 to 1,500 tons per day.

The feature of greatest interest in the improved plant is the electric pump. This is the first electric pump introduced in the mines of that section, and its successful operation is being watched with great interest by all interested in mining matters. The pump is of the horizontal, triplex or three plunger style with 6½ inch plungers and 8 inch stroke. It makes 42 revolutions per minute, and, in its present location, throws a steady, solid stream of water through a four inch pipe a distance of 500 feet from the lower workings to the main pump. The capacity of the pump is 500 gallons per minute. Its entire weight, inclusive of the operating motor, is 6,600 pounds. The electric motor is a 7½ h. p. General Electric Company motor, and the generator, constructed by the same company, and located in the main engine house on the surface, is of 10 h. p. The power is transmitted to the motor over copper wires running down through the air shaft and along the roof of the mine for a distance of 1,700 feet. The pump and motor are mounted upon a wheeled truck and can thus readily be transported to any point in the workings. This quality alone is a strong recommendation to mine managers. The claim that the electric pump needed considerably less attention than the steam pump has been heartily admitted by the managers of the colliery.

By the use of the electric pump a great danger in this mine has been obviated. The steam from the steam pump formerly used, penetrated the roof of the mine in the vicinity, loosening the rock, and rendering the possibility of its fall always imminent. Besides furnishing power for the pump, the electric generator on the surface supplies current to the incandescent lamps, which light the engine houses, the head of the shaft, the inside pump-house, and the workings about the foot of the main shaft. The contrast between the incandescent lamps attached to the roof along the main gangway and the illumination sparsely distributed from the ordinary miner's lamp, is most striking.



ELECTRIC MINE PUMPING AT DURYEA, PA.

If after a few months trial, the new system of lighting and pumping is pronounced successful, the colliery company intend still further to utilize electricity in their mine, and put it to other uses, such as to operate drills and locomotives.

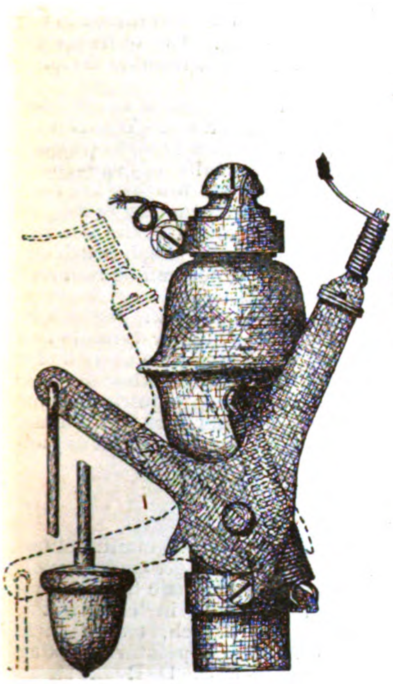
THE "PARKE PENDANT" GAS-LIGHTING BURNER.

THE "Parke Pendant," is a new electric gas-lighting burner, possessing several novel features and points of superiority. In this burner, which is shown in the accompanying engraving, there is no ratchet or complicated springs to get out of order. It is simple in construction, reliable in operation and absolutely safe in use.

To turn on and ignite the gas, the pendant is pulled. This movement brings the arm into the position shown by the dotted lines, and causes the spring (which is back of the arm, having been shown through in the drawing, to more readily explain its operation), which has passed its centre, or point of greatest tension, to hold it securely in that position, until released. To turn off the gas and extinguish the light, the pendant is slightly raised, upon which the spring will carry the arm, and also the gas valve (to which it is firmly attached) back to its original position.

As the position of the arm, which determines the position of the valve, can always be ascertained by taking hold of the pendant, all danger of allowing the gas to remain turned on, when from any cause the spark fails to ignite it, is avoided.

These burners cannot short-circuit. They are made in the best manner. Valves are all hand-ground, and thoroughly gas-tight. A pendant of suitable length, with solid brass acorn, is furnished with each burner. These burners are manufactured by Jno. J. Parke & Co., of No. 821 Cherry street, Philadelphia, Pa.



"PARKE PENDANT" GAS-LIGHTING BURNER.

THE NEW WESTINGHOUSE LAMP.

THE announcement now made by the Westinghouse Company in relation to their new lamps is of more than ordinary interest at this time as it foreshadows a departure not only in incandescent lamp construction, but a decided decrease in the cost of lamps to central stations and private consumers. We note the use in the lamps of an attenuated nitrogen atmosphere which replaces the residuary gas of the ordinary air heretofore employed. The Westinghouse Company claim that by this means the filaments are better preserved than where the oxygen atmosphere is allowed to be present before exhaustion begins.

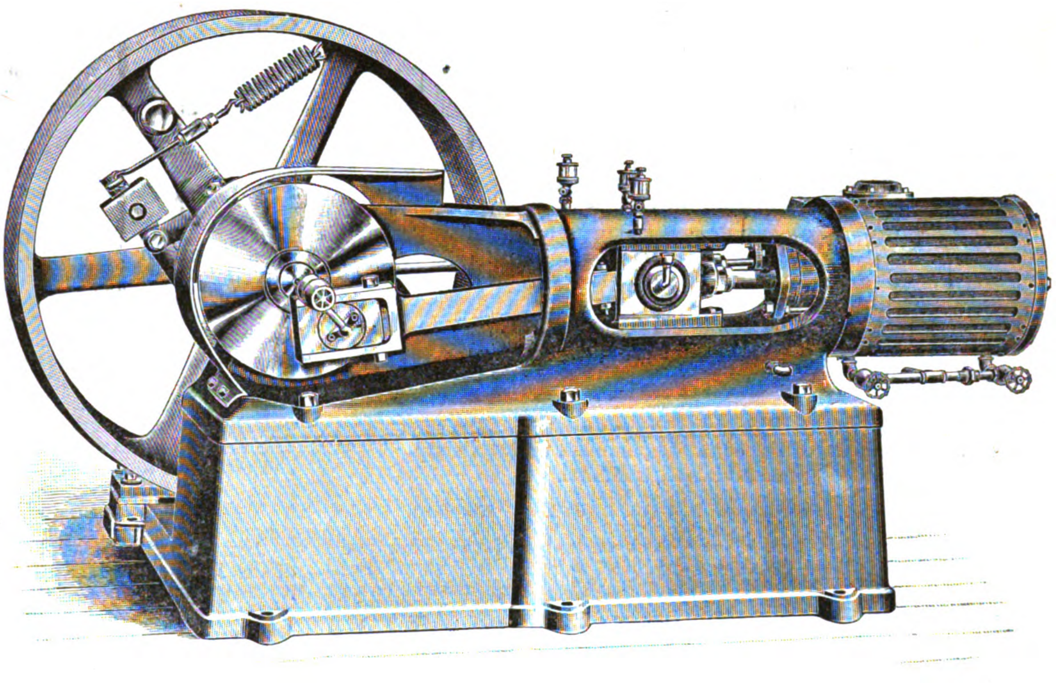
The lamp being made in separable parts the company also contemplates the renewal, on a large scale, of burnt out filaments. For this purpose it proposes to establish "renewal stations" in all the large business centres and thus to afford convenient and expeditious means of providing their customers with lamps having new filaments. With the discounts to be allowed, the cost of lamps to central stations for 8, 10 and 16 c. p. lamps will be 30 cents, subject to a discount of 10 per cent. and to others of 2½ per cent. upwards. In addition to this an allowance of 10 cents will be made for every lamp returned unbroken to the factory, thus making the cost of renewals 17 cents to central stations. For 20 and 25 c. p. lamps the prices will be 35 cents each, subject to the same discounts and allowances.

THE RACINE HARDWARE MANUFACTURING CO.'S ENGINE.

WE illustrate on this page the new horizontal engine, built by the Racine Hardware Mfg. Co., of Racine, Wis., who have until recently confined themselves to the producing of vertical, stationary and marine engines of a high grade. The company are hearty believers in the vertical type wherever they can be used, and especially in their own engines. This company probably carry the largest stock of engines of any builders in the country, with a view to the *immediate filling of orders.* At this writing they have by actual count 174 steam engines complete on the floor or in process. As they make 30 different numbers, they find such stock carrying necessary.

In these days of locating power in basements, there are places where the height of a vertical engine is objectionable. This has induced the Racine Company to commence building a line of horizontal engines from 35 to 100 h. p. in which they embody all that their long experience has proved to be the best. They are what may be called *reasonably* high speed, which means economy.

The engines are built to stand all the stress that their highest ratings demand, with broad margins for safety. It has come to be understood in engine construction that *quality* and not *quantity* of material should govern, which means the best material in the right place. The day has passed for estimating the value of an engine by the amount of pig iron put into it. It will be noticed in deciding what to embody in this their latest, that they have followed what is rapidly coming to be the conviction of practical mechanics and users of power (and at a considerable increase of cost) in supplying an outer support for their power wheels. Years ago this concern commenced building their engines without outbearings, but after costly experimenting and years of experience, they have decided that an out-bearing is necessary to the long life of an engine, thus securing what cannot be secured otherwise, the least wear, and uniform wear, the least time lost in repairs and the least cost of repairs.



RACINE HARDWARE MANUFACTURING CO.'S ENGINE.

IS GRAVITATION INVISIBLE BELTING?

THE SHULTZ BELTING CO., of St. Louis, Mo., had an exhibit and manufactured belting at the St. Louis Exposition, and the following incident is the result of a visit to that institution by one of the pupils of the Divoll School in that city :—

A few days ago a teacher in the Divoll Kindergarten was giving her pupils a little instruction in astronomy and the movements of the planets in the solar system, and said to a little boy: "Johnnie, what causes the earth and moon to spin on their axes like a top as they do?" "That there strap," answered Johnnie. "What strap? What do you mean?" inquired the mystified teacher. "Why," said Johnnie, "I seen on one of them picture cards down at the exposition of that company what had that machine what chops pieces of leather up into little squares, a picture of a strap running around the earth and moon, making them spin around like a top."

WESTERN NOTES.

New Offices. For some time past The Electrical Engineer has found its Western office quarters too small, and it therefore has much pleasure in announcing that while remaining in the same building—the Rookery—it has secured much better accommodation there. Mr. Leslie W. Collins, the Western Editor and Manager, will now be found in Room 575, a large office overlooking La Salle street, one of the busiest thoroughfares in Chicago. He will be glad to see there all the friends of The Electrical Engineer.

The Electric Appliance Company are opening the season by making a particular push on the New England Double Pole Switches. They have held the agency for this switch for the past year and have placed a large number of them although they have always been high in price. The manufacturers have known that they had a good thing and as they have always had all the orders they could handle have not cared to reduce their price to the basis of other makes. Having increased manufacturing facilities now however, it has been decided to make a cut in price and increase the business, and the Electric Appliance Company are preparing for a largely increased demand.

The Card Electric Motor and Dynamo Co., Cincinnati, O., are pushing work as hard as they can on their fine new factory, but meantime are seriously crowded in their old manufacturing quarters, and have had to remove their offices in order to get more elbow room. They have temporarily established their offices in the Fosdick Building, 59 West Fourth Street, Cincinnati.

Mr. F. W. Best, formerly with F. W. Best & Co., Denver, Col., has been appointed Eastern representative of the new monthly magazine, *World's Fair Electrical Engineering*, with headquarters in the Tribune Building, New York.

The Crane Company, of Chicago Ill., have secured the agency for the Western states for the De Rycke centrifugal steam separator and grease extractor, and are now equipping several electric light central stations with this device.

The Enterprise Electric Co., W. C. McKinlock, president and treasurer, have found new and larger quarters at 307 Dearborn street, Chicago, giving them a store 25 by 125 feet, with basement corresponding.

Dr. J. A. Hornsby has been nominated by Director General Davis as Assistant Chief of the Department of Electricity.

THE NEW MATHER DIRECT COUPLED DYNAMO.

In cities where land is very valuable and buildings rival each other as to which can get nearest the sky, the division of space and its utilization for the steam plant, heating and ventilating apparatus, electric light system, and other apparatus which has to go in the basement and is necessary to make the modern office building or apartment house complete, has become a very serious question with architects, builders and owners of large buildings.

Preparatory to submitting plans for an electric light plant, the writer recently called upon the owner of a large business block in New York. The first question was: "Where do you want to place your engine and dynamo?" This was a puzzler! Every available feet of space was occupied, and the only vacancy that could be found was about six or eight square feet out under the sidewalk. What was to be done? Belting and counter-shafting were an impossibility. Nothing would do but a dynamo that was coupled direct to the engine and built on the same base.

In nearly every large building in our cities, cases similar to the above will present themselves. The Mather Electric Company of Boston, Mass., was among the first to realize the situation, and after many months of experimenting, have developed and perfected a slow speed, multipolar dynamo which can be coupled direct to any first-class high speed engine.

The dynamo itself is one that does not require special or expert care. No electrician is needed especially for it, and any steam engineer after a few instructions can take entire charge of its operation. The Mather dynamo, throughout, is built upon thoroughly scientific principles, and is theoretically perfect in electrical design. Its efficiency is as high as that of any high speed machine, having as large a capacity in lights per horse power and consuming as little fuel as the best direct current incandescent machines.

The electrical design lends itself very readily to superior mechanical construction and full advantage of this fact is taken which gives the smallest number of wearing parts and least liability to get out of order. The result is a system that is absolutely reliable under all circumstances and a machine perfect in all its mechanical details.

The advantage, electrically, of the form of magnet used in the Mather system is so great that carefully conducted tests have shown that its form is the best that could be adopted. There are no joints, breaks or abrupt corners to oppose the passage of, or to direct the lines of force, points which are of great importance in a magnet. A large part of the success of the Mather system is due to this particular form of field magnet.

In place of using cast iron for the field magnets, cast steel is used entirely. The permeability of this material is greater than cast iron in the ratio of about nine to five, which allows of a great saving in space and weight. Being easier to create a greater magnetic strength than in cast iron, it materially reduces the size of the fields and greatly increases the efficiency.

The armature is a modification of the well-known Siemens type, the object being to design an armature that would produce the current without destructive sparking, and at the same time to do away with all unnecessary losses due to Foucault currents, and other sources of loss. The armature is carefully balanced and runs perfectly true and without vibration. When operating under full load there is no undue heating, a very important point.

All armatures are slotted and the wires imbedded. The mechanical advantages of the armature wires being provided with a perfect iron-clad bed are, that the slot thoroughly protects these wires from external injury, and prevents stripping off, due to a possible short circuit in the case of generators, and to sudden starting in that of a motor. The tooth projections decreasing the air gap, the slotted armature provides also a more perfect continuity of the magnetic circuit.

The shaft is of the best quality of steel, ground on dead centres, and is of ample size so that when connected direct to the engine shaft there is no tendency to springing. The bearings are self-oiling, and the plan employed insures the continuous flooding of the entire length with oil.

Sparking at the commutator is the cause of most of the trouble that comes to users of electric lighting apparatus. The Mather machines are so perfectly balanced, both electrically and mechanically, and the brushes and holders so carefully adjusted, that there is practically no sparking, and when the brushes are once properly adjusted the least attention given them the better, as they gradually adjust themselves to the commutator, and will run for a great length of time without being changed. Each brush can be adjusted independently by a simple device, or can be removed from the commutator by a single movement.

In the regulation of the Mather dynamo, automatic regulators, so called, are entirely done away with. The Mather dynamo is a perfectly automatic machine in itself, regulating absolutely under all changes of load without outside regulators, or other devices. It is also automatic in its consumption of power, requiring power only in exact proportion to the amount of actual work being done. The Mather dynamos for direct connection are built in all capacities from 200 to 3,000 16-c. p. lights.

NEW YORK NOTES.

Joseph De Rycke, 145 Broadway, New York, manufacturer of the De Rycke centrifugal steam separator and grease extractor, recently furnished to the Milwaukee central electric lighting station a second order of one 4 inch and one 10 inch separator, and a third order of five 4 inch, four 5 inch, two 6 inch, five 7 inch, four 10 inch and two 12 inch separators, making a total with the previous order, of thirty-six of the De Rycke steam separators and grease extractors in use in this station.

Mr. E. B. McClees, has, we are very glad to note, returned to an old post after two or three years of work in other directions, and may now be found at the Kerite headquarters, Mail & Express Building, this city. Mr. McClees has been so closely identified with Kerite interests that his return under Mr. Brixey's management will be hailed with delight by all old friends of the concern.

Chas. A. Schieren & Co., 45 to 51 Ferry street, have received a contract for all the belting for the new *Herald* Building, to consist of belts from 35 inches down to 12 inches; and also large orders from the Gas and Electric Co., of Wichita, Kan., and the Lima, Ohio, Electric Light and Power Co.

Captain Willard L. Candee, American manager of the Okonite Co., Ltd, sailed December 31st, on the North German Lloyd steamship "Saale" for London on business connected with the company.

Mr. Chas. P. Geddes has been elected secretary and treasurer of the Interior Conduit and Insulation Co., in the place of Mr. F. A. Mason resigned. Mr. Geddes is an old insurance man.

The General Electric Co. has secured an injunction against the Perkins Lamp Co., from the United States Circuit Court, at Hartford, Conn.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XV. JANUARY 18, 1893. No. 246.

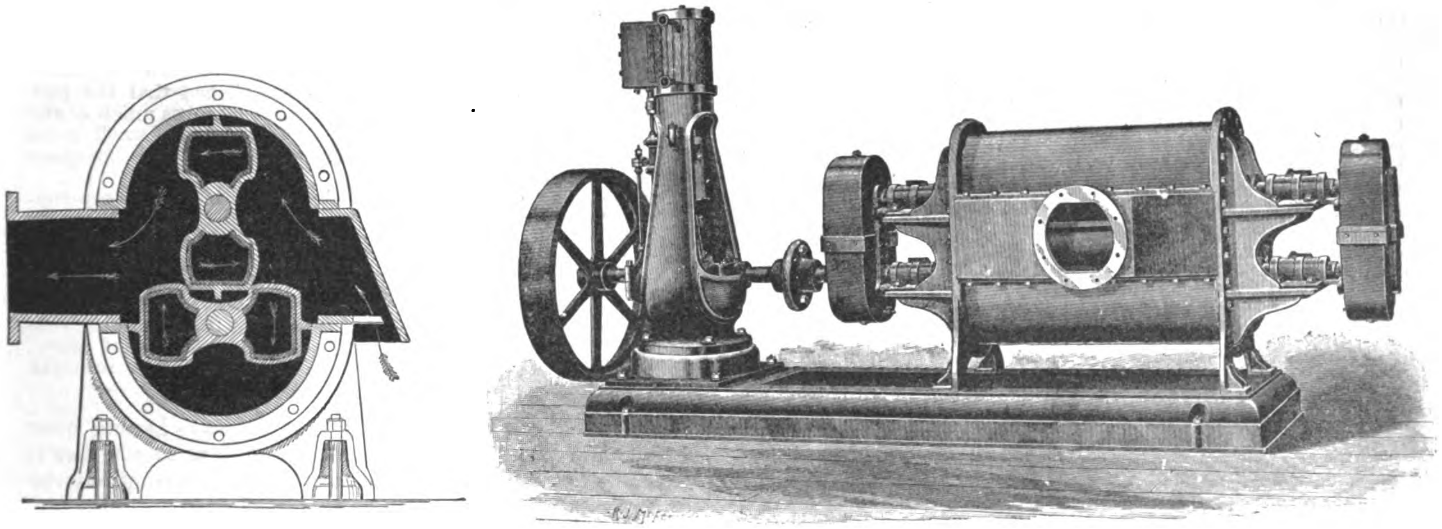
NEW YORK'S ELECTRICAL SUBWAYS.—III.

BY

Wm Maver Jr.

XI.—GAS IN THE SUBWAYS.

It is, I think, within bounds to say that the right to exist of an extensive electrical subway, designed to permit the free drawing in and out of cables from the ducts, in the streets of large cities, will depend upon the employment of a positive means of excluding from the subways the gas which may leak from adjacent gas mains.



FIGS. 19 AND 20.—APPARATUS EMPLOYED FOR BLOWING AIR INTO, AND EXCLUDING GAS FROM, THE NEW YORK SUBWAYS.

In Philadelphia, where, perhaps, the first "drawing in and out" subway system was employed in this country, (1882), the frequency of explosions of gas in the subways necessitated prompt action, and resort was had to blowers to expel the gas.

In New York city also, a number of explosions of more or less violence occurred within a comparatively short time after the construction of the first few miles of electrical subways. From May 9th, 1887, to March 25th, 1889, there were 12 such explosions. It was thus rendered obvious that a preventive of these explosions should be found, and various schemes, short of the expensive one of establishing and maintaining blower stations to exclude the gas from the subways, were devised and tried; with the result that the latter plan was adopted as the only effectual way of dealing with the question—assuming that the escape of gas from the gas mains would be permitted to continue. That this has been the proper method of dealing with the question is attested by the fact that not an explosion has occurred in the New York subways since the "blowers" were installed.

Much of the credit for the successful establishment of the "blower" equipment in this city is due to the study and work of Mr. Wm. J. Baldwin, the well known heating and ventilating engineer, to whom the matter was entrusted by Mr. Leonard F. Beckwith, the chief engineer of the Subway Company of this city. It will be evident from a reading of the numerous and interesting excerpts, which, by the courtesy of these gentlemen, I shall have the pleasure of quoting from Mr. Baldwin's reports on the subject, that he has made it his own.

The subject is one of so much importance to all who may contemplate the construction of electrical subways in other cities, where conditions more or less similar to those that exist in this city are to be encountered, that it, I think, well merits the space that may be given to it here.

There were, of course, various theories offered as to the cause of the explosions that occurred in the New York subways, some attributing them to the spontaneous combination of electrolytic hydrogen with atmospheric air, etc. One theorist asserted that a certain explosion was unquestionably due to the hydrogen set free from waters of condensation by a galvanic action set up between the lead covering of the cables and the iron of the ducts, citing in proof thereof that the workmen saw no flame at the moment of the particular explosion. The flaw in this theory was that the explosion in question had occurred in a creosoted wooden conduit.

To those, however, who were most intimately concerned, the cause of the explosions in the New York subways was not far to seek—namely, a spark, and an accumulation of illuminating gas in an explosive proportion with atmospheric air. The leaky condition of the adjacent gas mains did not leave much doubt as to the source whence the gas came, and the origin of a spark could readily be accounted for, if not directly traceable, as it was in several instances.

The work set Mr. Baldwin was "to examine the subways and manholes with a view to prevent the accumulation in the manholes and conduits, of illuminating and other gases in quantities sufficient to form explosive mixtures with air, or jeopardize the health of workingmen who are obliged to enter them."

"The chief cause of the vitiation of the air of the subways," says Mr. Baldwin in his report, "is the leakage into them of common illuminating gas from the many gas mains which run parallel to, or cross each other below the surface of the ground in the principal streets through which the electrical subways pass. The leakage of gas in the case of cast iron pipes, with hub and spigot joints, calked with lead, even when laid in the best manner, cannot be, or at least never yet has been, altogether prevented, and two per cent of such leakage from the mains may be assumed as occurring in the best practice. In the city of New York, this leakage reaches five or six per cent. In the older streets where several sets of gas pipes run parallel to each other, or nearly so, and when other pipes, as pipes for steam and water, and the sewers, parallel the gas pipes, the leakage is the greater; the joints of the gas pipes being injured by the frequent disturbance of the streets and the settling of the ground, the pipes and fittings also often being defective and the workmanship poor. Under the most favorable circumstances, however, as stated, there will be leakage of gas from the joints of cast iron pipes even with the low pressures carried in the mains, as every hub and spigot, with its lead filling, is an expansion joint, which has to accomodate itself to the expansions and contractions of the pipes. This change of length amounts to from $\frac{1}{40}$ to $\frac{1}{30}$ of an inch for every 12 feet length of cast iron pipe (and possibly more) for the range of temperatures in the ground to which the pipes are exposed at the depth at which they are usually laid—often not more than two feet below the surface. It is thus evident that absolutely tight hub and spigot joints can not be obtained and that the leakage of gas from the mains is not likely to ever be much less than at present, under the methods of laying the mains employed in New York. A more serious cause of gas leakage into the earth of the streets, constituting a large percentage of the whole, is that due to the wrought iron service pipes and their cocks and taps. These pipes corrode rapidly in the ground; many of them are pitted and broken and leak dangerously when the earth is removed from around them. Often the pipe is little more than a film of oxide of iron (rust) in the shape of a tube. Although many of these 'services' have been abandoned, they are not cut off from the main, and trouble from this source is more likely to increase than to diminish, in the future. In England and on the Continent the usual practice is to use lead or block tin service pipes, with brass taps, for gas. This custom adopted here would tend to greatly diminish the leakage which is now so general and troublesome, not only in the electrical subways, but also in the cellars of buildings adjacent to the gas mains.

"The second cause of the vitiation of the air in the subways and manholes is excessive dampness (vapor caused by heat), which in some cases amounts almost to steam; percolation of water from low wet ground or from sewers, and permeation of sewer and other gases through the walls.

"The leakage of the gas from the mains into the earth of the streets, causes pressures slightly above atmosphere. This excess of pressure causes movement of the gas in the direction of least resistance, that is, upward to the surface and into such cavities as exist below the surface. The leakage of gas into the cavity results in the gradual displacement of a part of the air, gas taking its place, until an explosive mixture is formed.

"To prevent the formation of this mixture in the manhole vaults, they must either be aired so thoroughly and continually that the gas will never accumulate in sufficient quantities to form an explosive compound, or measures must be taken to prevent the entry of the gas into the manholes."

As has been already stated in the description of the manholes, they are built in a manner which would seemingly prevent the intrusion of gas, but experience has shown that the constant heavy jarring to which they are subjected, sooner or later produces minute fissures in the walls through which gases percolate into the manholes. Experiments have been made to determine whether painting the walls of the manholes would keep back the gases in the earth, but the result was disappointing. In Mr. Baldwin's opinion the painting or coating of the bricks with any substance is of little or no service except that, in connection with plenum, or pressure, ventilation, a cement might be employed to lessen the outward leakage of air through the vaults at points where such leakage was found to be excessive.

Many experiments were also made with siphonic ventilation. Vent pipes about two inches in diameter were used in some of the manholes. One pipe connecting with the upper part of the manholes entered a lamp post; a similar but shorter pipe, with a bend in it, was carried from a few inches above the curbstone to the bottom of the vault.

"The purpose of this arrangement of pipes was to set up and maintain siphonic action, the long leg of the siphon, or lamp post, exhausting the air from the manhole and producing a slight condition of vacuum therein, while fresh air was drawn into the manhole through the short leg of the siphon. This result was attained to a limited degree. A small piece of paper when held over the inlet, indicated a general inward current through the induction pipe or short leg of the siphon; though this current was at times interrupted and reversed by slight back-draughts. The strong smell of gas at the head of the outlet pipe was also an indication that, at least on a sunny day, this apparatus had some aspirating power. By contrast with the unventilated manhole, this method of ventilation was not without beneficial results, which were evident also in the comparative dryness of the vaults. The ground and brick-work were drier and the gases were not so apparent to the smell. The presence of gas in it, however, was apparent and how long a person could safely work there is uncertain, while the question of the safety of taking a light into the vault could not be determined, as it is a well-established fact that mixtures of air and gas which are explosive can be breathed for some time without injury. And it is also known that when the specific gravity of the gas is greater than that of the air an explosive mixture may lie near the floor, while above it may be one which can be breathed for a considerable time with safety. This condition is always to be feared in unventilated manholes, and even when the manholes are ventilated as just described, there is no assurance that the danger is removed, and the same precaution should be taken as with the unventilated manholes.

"When manholes in damp districts are first opened, the smell of gas seems to be stronger than in the case of manholes in drier ground. This, however, may not indicate more danger from explosion. It may be simply due to the condensation of tarry or volatile substances by the aqueous vapors, which hold the tarry substances in suspension, causing the more pungent smell. These strong smelling vapors may, however, be less dangerous than the inodorous vapors or gases, for it is well established that the passage of illuminating gas through the earth removes much of the odor by which we detect the gas, so that the sense of smell is not to be relied on to decide the question of safety, unless the space has been well aired.

"The use of ventilating manhole covers has also been suggested. These are covers with perforations through them, to permit the excess of air or gases to pass off; but the movement of air through them is very feeble and unreliable and they may be disposed of by saying that ventilated covers of any description give no assurance of positive action, even under the most favorable circumstances. Water will pass through them into the subways, and they would be absolutely useless in times of snow, while in dusty weather they admit all kinds of refuse into the manholes."

These methods of ventilating the subways having been shown to be insufficient, the question arose as to whether it would be better to purify the subways by pressing out the impure air or by drawing it out by suction.

"When air is discharged into an open manhole, at pressures a little above atmosphere, by fans or blowers, in quantities sufficient to produce thorough airing, the pipes which convey the air require to be of comparatively large diameter, as the escape of air from the open, or partly open manholes, or from the vent pipes, will reduce the pressure. In these circumstances, to carry sufficient air a mile or more through the subway ducts would be impracticable and enormously expensive. If, on the other hand, airing is effected by vacuum movements, produced by an exhausting fan, the pipes must be equally large and expensive, and the air drawn to the fan will become so foul that tall chimneys will be needed to effect its discharge without creating a nuisance. It is evident that this method will aggravate the danger of drawing an explosive mixture into the air pipes and fan, and of destroying the plant by explosion. A vacuum or exhaust fan system of any kind also tends to draw the gases out of the ground and into the cavity that is being ventilated or aired. This, in some cases, must be very injurious and defeat the object of ventilation; as when the exhausting operation results in drawing quantities of gas from a large leak near by, into the very manhole it is desired to free from the gas. The lessening of pressure in the manhole increases the influx of gas from the earth and consequently a greater quantity of air must be drawn into the manhole or cavity to keep it at the required standard of purity. On the contrary an excess pressure in the manholes tends to diminish the leaks from adjacent mains, etc."

As already mentioned the foregoing considerations led to the adoption of the pressure system of ventilating the electrical subways of New York City, the plan adopted being to provide by suitable blowers and pipes a pressure in the manholes and ducts greater than the gas pressures in the surrounding earth, and sufficient to renew and change the air in the subways, at least once an hour, the subways being kept as air-tight as possible throughout their length, and the air forced into them being compelled to force its exit through the porous brick walls of the manholes and the surrounding earth, and through the walls of the ducts or accidental leaks in them.

Mr. Baldwin found the cubic contents of the average manhole to be about 250 cubic feet, and estimated the leakage through the walls of the manholes now used, with cover and rubber gasket, at about 500 cubic feet, per hour. The leakage from the wrought iron ducts may be disregarded; that from the cast iron ducts may be placed at about 500 cubic feet per hour, due to defective joints. This, for wrought iron ducts, would require a supply of 500 cubic feet, per hour; and for cast iron ducts a supply of 1,000 cubic feet, per hour, per manhole. There being about 24 manholes per mile of subway, "a mile of subway would require about 12,000 cubic feet of air, per hour, when wrought iron tubes are used and about twice this quantity with cast iron ducts."

In view of the fact that the ducts of the subways could not be utilized for the transmission of this air supply, since they are designed to be filled with cables, special ventilating pipes have been laid parallel to the subways. "A smooth pipe six inches in diameter (shown at the right of the distributing ducts in Fig. 4) is found of sufficient capacity to deliver the required amount of air, 12,000 cubic feet per hour, at a distance of one mile from the blower station with a loss of pressure for friction of about 14 ounces per square inch, so that with 16 ounces of inital pressure a terminal pressure of two ounces is available. A pipe, 8 inches in diameter, will pass 24,000 cubic feet of air through a mile of its length with a loss of pressure of somewhat less than 11 ounces per square inch."

In the laying of these ventilating pipes, they have been extended through each manhole with as little change of grade as possible, and lateral changes of alignment, to avoid obstructing the entrance to the manholes, are made with long easy bends, so as to minimize the loss of pressure due to friction of elbows and change of direction.

XII.—THE BLOWER STATIONS.

The adoption of this low pressure method of ventilating the subways necessitated establishing "blower" stations at different parts of the subways to properly air them. There are now in operation 12 blowers in nine different stations. These stations are enumerated in the subjoined table. The blowers used are manufactured by P. H. & F. M. Roots Co. The blowers are, of course, operated every hour of the 24. They are driven by steam and gas engines, respectively, depending on whether steam can be readily obtained from adjacent boilers. At the station, 145 East Forty-second street, two gas-driven blowers are employed. The gas engines employed are of the Otto manufacture and are, as is well known, self-regulating. An automatic pressure recorder shows, by a card, the pressure maintained by the blowers throughout the day. The steam engines operating blowers are attended to by the engineer in charge of the steam power plant. The gas engines are attended to by an engineer who visits the various stations in rotation. As showing the adaptability of the gas engines to this work it may be stated that the engines in question have been running for three years constantly without repairs and only an occasional shut down for half an hour to allow for cleaning the valves, etc. Figs. 19 and 20 show the blower used and its internal construction.

The following table, kindly furnished by Mr. Baldwin, contains interesting data concerning the blowers, the engines, gas consumption, etc.

Location of Station.	Nature of plant.	Cubic feet per rev.	Pressure of air in oz.	Rev. of engine per minute.	Rev. of blower per minute.	Engine.	Air resistance to blower in h. p.*	Total h. p. not over.	Daily consumption of gas in cubic feet.
	Blowers.								
16 Cortlandt street......	No. 5....	28	15.26	109.76	109.76	8″ x 12″ horiz. steam engine..	13.41	15.	
20 Cortlandt street......	No. 6....	42	4.	100.	100.	8″ x 12″ horiz. steam engine..	4.581	10.	
140 Spring street........	No. 5...	28	7.	120.	120.	8 x 8 vertical steam engine...	6.414	8.	
208 Elizabeth street.....	No. 5....	28	10.	140.	100.	9 x 9 vertical steam engine...	7.63	9.	
Broadway and 14th street	No. 5....	28	9.87	110.	110.	8 x 8 vertical steam engine...	8.29	10.	
8 East 18th street........	No. 5....	28	3.	170.	84.	10 h. p. Otto gas engine......	1.923	4.35	2393⅓
113 West 38th street.....	No. 5....	28	7.	135.	135.	8 x 8 vertical steam engine...	7.216	10.	
115 West 38th street.....	No. 5....	42	6.	120.	60.	8 x 8 vertical steam engine...	2.06	8.	
145 East 42d street. West	No. 5....	28	13.9	170.	68.	10 h. p. Otto gas engine......	6.65	8.4	4623⅓
145 East 42d street...East	No. 5....	28	9.5	172.	66.	10 h. p. Otto gas engine......	4.8	6.79	3736
207 East 111th street....	No. 4....	13	14.	160.	84.	7 h. p. Otto gas engine.......	4.172	6.67	3670
230 East 125th street.....	No. 4...	13	5.	168.	108.	7 h. p. Otto gas engine.......	1.91	4.2	2313

* Exclusive of friction of engine, blowers, shafts, belts, etc

TABLE OF SUBWAY BLOWER STATIONS IN NEW YORK CITY.

The blowers in each station are allotted a territory embracing about two miles of subway in two diverging directions from the station and could supply sufficient air for a radius of one and a half to two miles, if necessary.

Where the air pipes leave the blower station and up to a point where the subways diverge, they are of double the capacity of the ordinary air pipes, namely about 12 inches in diameter. Openings which admit of graduation are made in the air pipes where they pass through manhole vaults. These openings range from ⅛ of an inch near the stations to ¾ of an inch at the more remote points. By this arrangement it is clear that air pressure will be maintained in the subways whether or not intermediate manholes be, for any reason, open. The pressure at the ends remote from the blowers is in some cases very slight, but still ample for the purpose.

The question of utilizing high pressure engines and smaller air pipes to operate at greater distances than is feasible with low pressure, thus requiring fewer blower stations, was, as before intimated, fully considered, but the greater economy of operation, etc., of the low pressure led to its adoption.

While it is obvious that but for the presence of illuminating gas in the subways, it would in all likelihood not have been necessary to have incurred the expense of establishing this extensive "blower" system, it may be noted that the forced passage of fresh dry air through the conduits and manhole vaults has had a very marked effect in keeping them dry and wholesome and will from present appearances much enhance the longevity of the entire plant.

There are, it may be said, thus far no marked signs of detorioration of the material of the iron, asphalt, wooden or other conduits of the New York subways. Examinations that have been made of some of the cast iron ducts of the Johnstone conduits, which were laid directly in the earth, show only trifling marks of corrosion.

THE RELATIVE ADVANTAGES OF CONCENTRIC AND DOUBLE CABLES.

BY

Morton. E. Eden

As concentric cables are rapidly coming into use, especially for high pressure alternating currents, it would be interesting to hear from some of your readers their experience as to the durability and advantages discovered.

The relative merits of concentric, as compared with two separate cables, have attracted a great deal of attention abroad, where they advocate their use for high pressure alternating currents. Of course there is a great deal that can be said against their use, but then again there are no doubts as to the advantages attained, for instance as regards the question of induced currents in neighboring wires, for as long as the insulation is good, there is no induction, owing to one conductor being concentric with and enclosed by the other. This is very important when telephone, telegraph and other wires are run parallel with, and in close proximity to, alternating circuits.

Of course, with two separate cables run close together, as for instance in the same conduit, no trouble would be experienced from induction; but, two separate cables do not, as regards their insulation, stand the strain of pulling in so well as a concentric cable, because it matters very little if the insulation on the outside of a concentric cable is slightly damaged.

As to safety to the linemen and public, the concentric cable is undoubtedly better under certain conditions of working, than two separate ones, for if the capacity of the outer conductor with regard to the earth is considerable and the insulation of all parts of the circuit is good, the mean potential of the conductor is the same as that of the earth, and the greatest difference that could exist between the two is that due to fall of pressure, caused by the flow of current in the cable. But if the circuit is faulty, in the converter or at any fitting, the point at which the leak occurs will be of the same potential as the earth and these no doubt will show under given circumstances, a considerable difference of potential.

Mr. Ferranti, I believe, suggested a method of overcoming this difficulty, to ensure that only a small difference of potential can exist, by connecting them electrically at some part of the circuit, and he adopted it in the mains of the London Electric Supply Co., London, England, where with two separate cables laid underground, so that their outer coverings are earthed, the danger of a shock is removed, except when some part of the cable itself is touched. This same danger occurs in circuits where the cables are concentric, unless the concentric principle is carried through to all connections to converters, switches, etc. But the degree of safety obtained by the use of concentric cables over two separate cables is no greater unless the outside covering of the concentric cable is earthed throughout the whole system.

In concentric cable systems as regards testing of insulation, etc., a difficulty is met which is not experienced in a system of two separate cables, for when an insulation test between the two conductors of a concentric cable is required to be made, all connections between dynamos and other apparatus must be disconnected, which is hardly practicable.

As regards the use of lead covered cables for alternating currents, it seems that it would be best to use concentric cables, as with a single conductor cable there must be an appreciable waste of energy from induced currents in the lead covering, this waste does not occur in concentric cables. The higher the frequency, the greater the waste of energy.

Relative to jointing, greater, though not seriously greater, difficulty is met with than with single conductors, more especially with T-joints; but a special junction box will facilitate the making of most joints. It would be most interesting to hear more about the use of concentric cables and their advantages over two separate cables.

One company in London, England, is laying down concentric cables for the alternating system now being installed for the city of London lighting, some circuits having been in use for some months and no trouble whatever being experienced.

INSULATED ELECTRIC CONDUCTORS.—XVI.

BY

James Bowstead Williams M.R.C.

Shellac.—This substance is one of a distinct group which includes copal and amber. It is considered by many to be an animal product, but from an intimate acquaintance with its properties, and after having used it in almost every possible way in which it could be used in the arts, both in its pure state—*i. e., before* it had been "handled" by dealers—and in combinations, the writer believes that it is a vegetable and not an animal product. It is true that it is a very peculiar substance, as regards its combinations, etc., and often behaves in an unaccountable manner when in the hands of a novice; yet, when pure, it is one of the best materials for insulating varnishes, and other compositions, as well, that we possess, and it is well worth the time and study which are necessary to bestow upon it if one is to derive the best results from its use. It is a *very* "select" resin, and does not enter into combinations as readily as most other resins. Being very brittle, the cases are few in which it can be used alone, and, except in special cases, it should be combined with other and tougher substances. When used for varnishes its proper solvent is alcohol. When dissolved in linseed oil it can be thinned with oil of turpentine, if desired. It will dissolve in boiling alkaline solutions in a few minutes. These solutions when used alone or added to glues form useful cements for labels, etc., but not for insulating purposes unless the *dry* layers are *immediately* covered with a suitable waterproofing layer. Shellac will *invariably* crack if applied to fibre or wires which are alternately heated and cooled, unless properly combined. Directions for separating the pure resin from the gum have been given in a former article. This resin forms one of the best lacquers for the exposed brasswork testing and other electrical instruments that can be obtained, for it not only embellishes the work but insulates as well.

Like copal, shellac can be directly combined, when in solution, with other substances provided they are compatibles and are dissolved in the proper solvent. As found in the stores, it is adulterated with rosin. While this may not lower the specific resistance of the material to any great extent, it does diminish its durability, and that in proportion to the amount of rosin present in the mixture. Always reduce the shellac to a coarse powder before using.

Japan driers containing a large proportion of shellac are the best for insulating paints. Formulas for such can be found in the books; but greater care must be taken in making driers for insulating paints than those for ordinary paints.

Shellac is very capricious when used with bituminous matter, especially after standing for a few days.

The writer cannot do better right here than to state a rule which he has followed with the most satisfactory results while making solutions for insulating purposes, namely: Always examine a drop of the *fresh* solution with the microscope, and repeat the examination every two or three days, of the *original* solution. The drop is placed between cover glasses, and examined with low powers. A little practice will enable the operator to distinguish between chemical solutions and mechanical mixtures, and also to detect changes, if any, in originally chemical solutions, but which cannot be detected by ocular examination.

Colophony.—This is a useful ingredient of paints, for it not only unites readily with other substances but also serves as a "binding material" for substances which do not readily combine. It dissolves freely in oils and volatile solvents.

Rosin is best used by first melting it with other material and then dissolving. As a rule the softer kinds are the best because they contain more oil and turpentine than the harder and brittle kinds, which causes them to combine easily with the other material and also to assist in making the paints elastic and tough. High temperature and frequent melting do not injure rosin, as they do shellac, but every time it is heated it becomes more brittle. Rosin oil is a good ingredient for compound solvents.

Bituminous Matter.—This includes those natural and artificial petroleum products which are known as asphaltum, maltha, etc. These differ from each other principally by the proportions of petroleum they contain. As far as *durability* and *flexibility* are concerned—for any asphalt can be made flexible by adding petroleum to it, using heat—there is probably nothing better known, but, unfortunately, the specific resistance of such material is low, as compared with rosin, for example. Were it not for this fact we could not wish for a better paint than maltha dissolved in bisulphide of carbon either with or without the addition of resin, paraffine, etc., to it.

Regarding the effect of asphalt upon highly insulating compounds of which it forms an ingredient, the writer found that the specific resistance of such compounds is not materially affected until the asphalt constitutes about twenty per cent. of the whole. After that the resistance diminishes rapidly as the proportion of asphalt is increased. This was found to be the case with *all* bituminous matter used by the writer.

None but elastic or flexible asphalts should be used in paints. They combine with nearly all kinds of insulating material, and impart their properties, to a greater or less degree, to all compounds in which they are used. They dissolve freely in almost all solvents, and form the best *protecting* paints known, whether exposed to air or immersed in water. Ordinary chemical agents affect them but slightly or not at all. Owing to the constant changes by oxidization and evaporation of the volatile constituents of the petroleum they contain, they become more brittle, when exposed to air. They can be melted with compatibles and then dissolved, or else dissolved separately and then added to other solutions.

LAMINATED OR DIVIDED IRON AND OTHER METALLIC MASSES IN ELECTROMAGNETIC APPARATUS.—III.

BY

Thos D Lockwood

The French philosopher Masson experimented considerably with induction coils during the years from 1837 to 1842, and published two memoirs upon the subject in the *Annales de Chimie et Phys.*, one by himself only (Vol. lxvi, 1837, pp. 5–28), and the other in conjunction with Breguet, (Vol. iv, 1842, p. 129); and Prof. S. P. Thompson says in his historical notes, introducing the chapter on "Transformers" in his "Dynamo Electric Machinery," that Masson "introduced a bundle of iron wires as a core." Page, however, is silent in this regard, although he speaks of both of Masson's papers; and I have not been able myself to examine the papers to see how Masson stands; I cannot, however, resist the impression that Prof. Thompson must have overlooked this part of the work of Sturgeon, Bachhoffner and Page.

ARAGO.
(*From Scribner's Magazine.*)

In the latter part of 1838, a master mind, gave some little thought, in connection with other matters, to this part of the subject: This was Henry. On November 2, 1838, he presented to the American Philosophical Society a paper on "Electro-Dynamic Induction" which has become a classic. This was recorded in the *Transactions of the Amer. Phil. Soc.* (N. S. Vol. vi, pp. 303–337); and is reprinted in the "Scientific Writings of Joseph Henry." (Vol i, pp. 108–145).

It was also reprinted as early as March, 1840, in *Silliman's American Journal* (Vol. 38, pp. 209–243); and in *Sturgeon's Annals*, (Vol. iv, pp. 281–310, 1840).

Henry details his experiments and shows (Sec. 72) that in using two coils, if one be enclosed in a hollow iron cylinder, it would be screened from the inductive action of the other; as was indeed also the case when a brass cylinder was used. He proceeds (Sec. 76) to show that the dulling effect is probably due to parasitic currents, and as his language cannot be improved on or made more terse, I quote it:—Sec. 76. "Also the same principle appears to have an important bearing on the improvement of the magneto-electrical machine: since the plates of metal which sometimes form the ends of the spool containing the wire, must necessarily diminish the action, and also from experiment of paragraph 72, *the armature itself may circulate a closed current which will interfere with the intensity of the induction in the surrounding wire.* I am inclined to believe that the increased effect observed by Sturgeon, and Callan, when a bundle of wire is substituted for a solid piece of iron *is at least in part due to the interruption of these currents.*"

Thus we see that Henry, at this early date, had seen with the eye of genius these parasitic currents; had foreseen their effect, and had determined how they might be prevented from exercising a damaging influence on the work of magneto machines. Henry then concludes his paper by the following most interesting note:

> "On the evening of the meeting at which my investigations were presented to the Society, my friend Dr. Bache, of the Girard College, gave an account of the investigations of Professor Ettingshausen of Vienna, in reference to the improvement of the magneto-electric machine, some of the results of which he had witnessed at the University of Vienna about a year since. No published account of these experiments has yet reached this country, but it appears that *Professor Ettingshausen had been led to suspect the development of a current in the metal of the keeper of the magneto-electric machine; which diminished the effect of the current in the coil about the keeper, and hence to separate the coil from the keeper, by a ring of wood of some thickness, and afterwards, to prevent entirely the circulation of currents in the keeper, by dividing it into segments, and separating them by a non-conducting material.* I am not aware of the result of this last device, nor whether the mechanical difficulties in its execution were fully overcome.
>
> "It gives me pleasure to learn that the improvements, which I have merely suggested as deductions from the principles of the interference of induced currents, should be in accordance with the experimental conclusions of the above-named philosopher."

This note accompanies the reprint of Henry's paper in *Silliman's Journal*, (March, 1840), as well as in *Sturgeon's Annals of Electricity* (Vol. iv, pp. 309–310).

At this stage, the Genesis of the Lamination appears to have been fully accomplished; and what comes after, concerns its evolution and practical application; for as we have seen, the utility of finely divided iron in appliances comprising electromagnetic apparatus was recognized by Sturgeon, Bachhoffner and Page, and was published by each of these; the efficacy of insulating the divisions from each other had been clearly disclosed by Bachhoffner. One of the reasons for the necessity of division had been suggested by both Sturgeon and Page; and the latter experimentalist, besides reaching his views inductively, as was indeed appropriate considering the subject, had moreover foreshadowed a second reason, namely the prevention of the eddy currents, which was more clearly indicated by Henry and Ettingshausen, this however having already been done in another relation by Faraday. And finally, Ettingshausen had actually reached the point of suggesting the cutting up of an armature core into discs for the elimination of such disturbing currents.

For any who may desire to dip deeper into the early history of the subject as outlined above, it may be of interest to state that an historical summary of the history of induction coils is to be found in the several later editions of Prof. S. P. Thompson's "Dynamo Electric Machinery;" that the two volumes of Prof. J. A. Fleming's excellent work, "The Alternate Current Transformer," are replete with valuable information concerning not merely the history, but the theory and practice, also, of the transformer, including the feature under consideration; and that those who can manage to procure and read the little book of the late Dr. Page on "The History of Induction," will be well repaid for the trouble.

The record of nearly all of the following instances of the evolution and application of the principle of dividing metallic masses exposed to induction, has been personally examined. It is of course probable that many others have occurred; and also that the record of even such as I am here able to give, may likewise be found in other languages, and in many contemporary publications, which I have not found an opportunity to examine.

This record will terminate with the year 1882, for the reasons, first, that by bringing it forward to that date we are enabled to include the famous Hopkinson choking coil patent; and second, because by the year 1882, the principles underlying the division of electromagnetic iron were fully understood, and their application fully appreciated by those "skilled in the art."

That able man, James Prescott Joule, was one of the earliest to observe the value of these principles. As early as December 1838, we find him writing a letter to Sturgeon. (*Annals*, Vol. iii, p. 437) on "An Electromagnetic Engine," in which he describes experiments made with solid and divided cores; and makes the following statement, remarkable for the time, that "the current of electricity produced by a magneto-electric machine is much increased by the insertion of a bundle of iron wires, instead of a solid nucleus of iron, into its coil—a phenomenon evidently occasioned by the peculiar texture of the wires, which allows Mr. Sturgeon's magnetic lines to collapse with greater suddenness."

He returns to the subject with a second letter in March, 1839, which also was published in *Sturgeon's Annals* (Vol. iv, p. 58) and recounts further experiments. In this letter he observes, after stating his results, that "the above results will not appear surprising if we consider, first, the resistance which iron presents to the induction of magnetism; and second, how very much the induction is exalted by the completion of the *ferruginous circuit*," which observation is most striking, since it comprehends the two modern doctrines of magnetic permeability and the magnetic circuit.

A British patent was granted on Sept. 24, 1840, to Henry Pinkus, which includes among other things "an electromagnetic break (meaning I suppose *brake*), in which a flexible armature of *thin laminated* plates lying on one another is attracted to an electromagnet." In this year also, we find a well-thought-out, and well-written paper, "On Electromagnetic Coil Machines," by Thomas Wright, published in *Sturgeon's Annals of Electricity* (Nov. 1840, Vol. v, pp. 349—352), which recounts many interesting experiments with induction coils, having coils made up of sheet iron strips, and hoop iron.

In 1843 we once more hear from Joule. On August 21 of that year, he read before the British Association a paper on "The Calorific Effects of Magneto-Electricity, and on the Mechanical Value of Heat," which later was published (*Phil. Mag.*, series 3, Vol. xxiii, pp. 263, 347 and 435). In this paper he described and used an electromagnet whose core was composed of "six plates of annealed hoop iron, each 8 inches long, $1\frac{1}{8}$ inch broad and $\frac{1}{16}$ inch thick," these being "insulated from each other by slips of oiled paper." He recognizes the existence of eddy currents, and says, speaking of the above magnet: "Although any considerable development of electrical currents in the iron of the revolving electromagnet was prevented by its disposition in a number of thin plates insulated from each other, I apprehended that they might under a powerful inductive influence exist separately in each plate to such an extent as to produce an appreciable quantity of heat."

A text book entitled "A Manual of Electricity, Magnetism and Meteorology," was, in 1844, written by Dr. Dionysius Lardner. In its second volume (p. 516) the author refers to Bachhoffner's discovery of the superiority of iron wire cores; says that Dr. Golding Bird and others promptly adopted them; that electromagnets are since made that way; and that Joule prefers square to round fibres.

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Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
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THE ELECTRICAL CONGRESS PROGRAMME.

INTERNATIONAL congresses are now the order of the day, and electricity has certainly had a lion's share among these gatherings in various countries, whither delegates have been attracted by electrical exhibitions. Indeed, probably few other branches of science could have got together such meetings of representative men. And now, close upon the late Frankfort Congress, we are already preparing for the one at Chicago. That such an early reassembling of electricians is necessary to determine doubtful questions and fix new units and names therefor, we believe to be beyond a doubt, and for proof we need only to glance at the provisional programmes submitted by the General Congress Committee of the American Institute of Electrical Engineers and by the corresponding English Committee. Though much good work has been done by previous Congresses, the advancing science has made it imperative to bring more strictly within the bounds of accuracy numerous definitions of electrical and magnetic quantities, to assign names for desirable additional units, and a dozen other questions of the first importance to the working electrician as well as to the scientist. Without entering here into a specific discussion of the committee's programme, which we print elsewhere in this issue, we wish to draw special attention to the excellent suggestion that an International Congress is the place to close, but not to open, a discussion on questions involving international agreement. Without wishing in any way to reflect on the work of previous congresses, which have done much good, we may remind those who have attended such gatherings in the past that even with the best intentions the time given to the subjects in hand is so brief and the members are so liable to be drawn away from the real business of such congresses by the many hospitalities extended on these occasions, that deliberate concerted action is almost out of the question. Hence the necessity of submitting to the members of the coming congress, the questions to be determined, in such a form that they can be acted upon with little if any discussion. Another point upon which too much stress can not be laid is the selection of official delegates by governments and representative scientific societies to determine the subjects to be definitely acted upon. It goes without saying that there can be no permanent international character endowed or conferred upon any unit for instance, without the action of a majority of international delegates. In other words, we hold that a general congress such as that to be held in Chicago, and open to everyone upon payment of a small fee, is not the body—unless divided into sections—to formulate, but merely to ratify, propositions submitted by competent authorities. The congress will probably consist therefore of an upper and a lower house. Our own countrymen will naturally constitute the large majority of the lower house—open to all,—and an "international vote" there would have but one result; it would be "patriotic" as it would in any other country under similar conditions. All of the committee's suggestions and recommendations are deserving of the most serious consideration, not the least of which is the call for open discussion by all of the propositions submitted. We shall be glad to aid in this work by opening our columns to those desiring to take up questions connected with the next congress.

Space At The World's Fair.

EXTRAORDINARY statements have been appearing lately in the Chicago newspapers as to the delay and disappointment in allotting space at the World's Fair. One article describes Director General Davis as imprisoning various chiefs of department in his office for two or three days until they had made some sort of disposition of the problems involved in dividing an utterly inadequate amount of floor space among thousands of eager applicants. Meantime, we are glad to be able to publish in this issue complete diagrams of Electricity Building, showing the chief allotments made there by Prof. Barrett and Dr. Hornsby. It is too much to expect that everybody will be satisfied, but credit must be given for an effort to do the best that the circumstances permit. It is interesting to note that foreign nations, particularly France and Germany, will be fairly well represented in this Building.

The "Deadly" Flagpole.

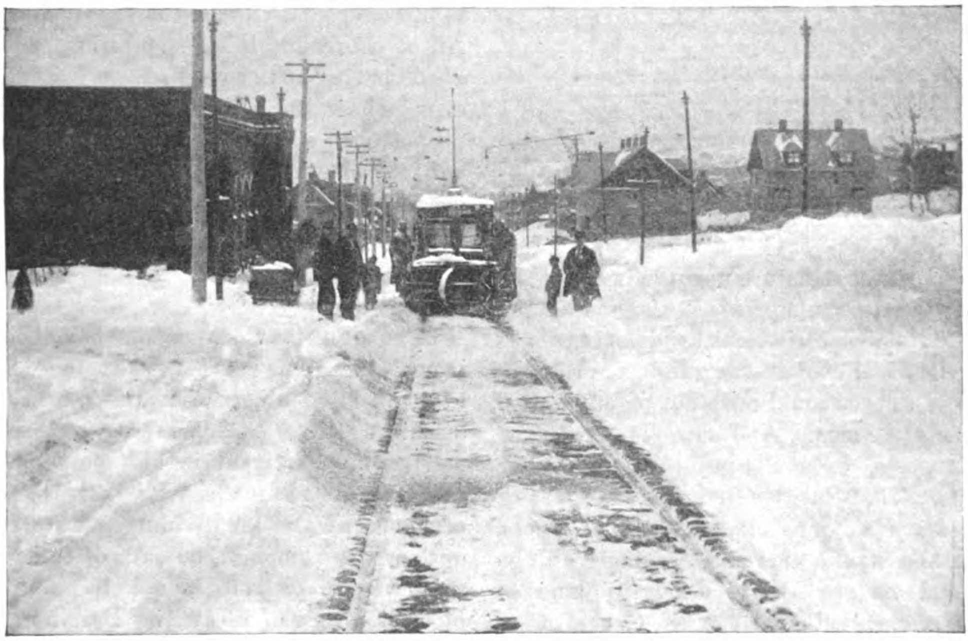
WE cannot refrain from expressing our sympathy with the crusade that Mr. David McAdam, of this city, has just began against the flagpoles that cap so many buildings. He says they are "a standing menace to life and limb," and that when thrown from the top of a building they are capable of doing "incalculable damage." This is, no doubt, true. A flagpole, like a trolley pole, is intensely deadly, even when standing stiff upright, 150 feet above the ground; and it is only due to the forebearance of the public that we so rarely hear of accidents with either.

ELECTRIC RAILWAY DEPARTMENT.

THE TROLLEY IN THE RECENT SNOW STORMS.

New York Rapid Transit, January, 1893.

IT is admitted on all sides that the present winter is the severest since 1888, while the snow has been as heavy and continuous as at any time during the past decade. Such a winter, therefore, and such a week as the past, should afford a good test of the ability of trolley cars to maintain their running schedule in wintry weather, and it is satisfactory to note that they have almost everywhere responded nobly to the call upon them. The worst interruption appears to have occurred at Toledo, Ohio, where about 100 motor cars got stalled or were unable to run out; but as the trains on 20 railways entering Toledo were from 5 to 15 hours late, it may be inferred that the ordeal was one before which everything had to succumb temporarily. In Brooklyn, N. Y., the trolley cars were the only ones running on time, while the Brooklyn elevated road and the horse cars were subject to great delay and the bridge cable service broke down. In New York city, the suburban trolley cars beyond the Harlem River ran very well indeed, but as our little illustration shows, the horse cars had a hard time. The sketch is reproduced from the *New York World*, which is opposing trolley cars and an extension of the elevated facilities, tooth and nail and tongue; so that our readers may infer what kind of rapid transit that journal wants New Yorkers to have.



CLEANING SNOW FROM TRACK WITH ELECTRIC SWEEPER.

In Boston the service of the West End road was maintained admirably. Mr. Dumoulin, the road's vigilant electrical engineer, informs us that they had out 80 snow-plows and sweepers. Each of these is run by two 25 h. p. motors, and the entire number work over about 160 miles of trolley system. They are sent out the moment snow comes on, with the result that as in the present instance, not a single trip was lost. A similar report comes from Brockton, Mass., and the local *Enterprise* says: "The officers of the electric road are deserving of all praise for the excellent manner in which they kept the tracks clear during the storm last week."

But perhaps the most encouraging report is that which comes from Philadelphia, where the trolley has been quarantined as though it were the cholera. The system is still young in the city, but the *Philadelphia Record*, one of the most progressive and public-spirited papers in the country says: "The superiority of the electric trolley lines in this regard was marked. All through the storm the cars on the Catherine and Bainbridge trolley system ran smoothly and on schedule time; and in Camden, where the horse cars were hopelessly blocked, the Market street trolley cars kept running without interruption. The storm has demonstrated the practical utility, value and reliability of the trolley system by the application of the logic of convincing and irrefutable facts. A system of street passenger transportation that could not be broken down even under the strain of last Thursday's storm may safely be commended to general use and acceptance."

ELECTRICAL MAIL TRANSPORTATION IN CITIES.

IN our last issue, the subject of handling mail by trolley cars was broadly discussed. The topic it a very important one, with many sides of interest, and tempting to the inventor. A few further details of what is being done in other directions may be given.

An act of congress, dated July 13, 1892, authorizes the Post-Master General "to examine into the subject of a more rapid dispatch of mail matter between large cities and post-office stations and transportation terminals located in large cities by means of pneumatic tubes or other systems," with the view of ascertaining the cost and advantages of the same. Accordingly Postmaster General Wanamaker caused advertisements to be inserted in various newspapers calling on all persons who were the inventors, or had the control of any pneumatic tube or other device suitable for the proposed service to present a full description of the same, which must include the kind and quantity of the motive power used.

The commission appointed by Postmaster General Wanamaker to examine the different systems, and consisting of Second Assistant Postmaster Bell, Third Assistant Postmaster General Hazen, and Mr. Maynard, of the inspection division of the post-office department, has reported in favor of the United States Automatic Dispatch Company of this city, which has agreed to put its system in operation between Brooklyn and New York and operate it for one year at its own expense, provided the postal authorities will accept it afterward if it proves satisfactory and to grant to the government the right to use its system outside of New York and Brooklyn at an annual rental of $150,000.

The system of which Mr. Andrew Bryson, of this city, is the inventor, is designed to be used not only in and between closely-adjacent large cities, but once its practicability has been established to the satisfaction of the postal authorities there is no reason why it should not be extended so as to connect cities miles apart and, eventually, over the whole country.

In this system the mail matter will be sent through a metal tube 16 inches square. The mail carrier is a steel box with closed ends and latticed sides. It is 5 feet long and about 14 x 14 inches square, thus allowing a small margin on all sides when in the tube.

For switching off carriers at intermediate stations, Mr. Bryson uses a guide rail fastened to the side of the tube, which engages with an arm fixed to the side of the carrier. At each sub-station on the line there is a guide rail at a height corresponding with a notch or slot and no two guide rails are of the same height. When a carrier is loaded with mail for a certain station the dispatcher places the engaging arm in the slot corresponding with the guide rail at that station. The carrier is then sent off. The engaging arm cannot engage with any other guide rail but the one it is intended for.

Each carrier has its individual motor taking current from wires at the bottom of the conduit.

The action of closing the dispatcher energizes the motor which starts off on its journey. On approaching the receiving station the passage of the carrier automatically cuts off the current and the carrier slows up. The approach of a carrier is signaled by a bell so that the possibility of starting another carrier ahead of the approaching one and thus running a risk of a rear end collision before the carrier last started has attained full headway is avoided.

Permission has now been applied for to lay conduits from the New York and Brooklyn post-offices to the approaches of the Brooklyn Bridge, and to suspend an aerial conduit beneath the Bridge itself. The Postmaster General has already granted the company the right to enter the two post-office buildings.

Among other devices for supporting pneumatic tubes, electric wires, etc., is one owned by the Aerial Conduit Co. of this city, the patents of which were taken out by Messrs. O. F. Smith, and A. A. Knudson; one of them as far back as 1881. This conduit has lately undergone slight changes by Mr. Knudson so that it is now adapted for transporting mail, or express-packages either by pneumatic tube or by electric motor.

A curious development of the situation has been the struggle for the control of certain stock in the Porte Electric system, of which several descriptions have been given in the THE ELECTRICAL ENGINEER. The idea is to handle mail, etc., by means of carriers which are of magnetic material and are sucked inductively through a succession of coils. There was great excitement at the Real Estate Exchange, in this city on Jan. 10, when Auctioneer H. W. Donald, of R. V. Harnett & Co., put up for sale 20,500 shares of the United States Porte Electric Company. J. Sidney Goldsmith, a broker, and Lawyer H. D. Loomis, beginning at $10, in a few minutes raised the bid to $1,800,000 for the lot.

Mr. Goldsmith purchased the stock, and he had no sooner done it than he was served with a notice from Charles F. James, the secretary and treasurer of the company, that the International Porte Electric Company, which had offered the stock for sale, had no right to it, and that purchasers buying it bought subject to his claim against it. The auctioneers have not delivered the stock and will not until the matter is settled. They claim about $9,000 commission on the sale.

Mr. James said that there was a new element in the company that was trying to push the old out. The sale was devised by one of these who had given bad advice to the other stockholders. The stock had been put up for sale by this element, without properly notifying or consulting other shareholders. Mr. James said he had been notified only the evening before. But he had had ample time, though, to have a legal notice served upon the would-be purchaser who wanted to get control of the company. Mr. James seemed to doubt that the sale would be effected in view of his notice. H. D. Hotchkiss, who represented the United States Porte Electric Company, said at the sale that the bid of Mr. Goldsmith had not been made in good faith.

THE CHICAGO & ST. LOUIS ELECTRIC RAILROAD BEFORE CONGRESS.

THE following despatch appeared in the *N. Y. Herald* of Jan. 13: Washington, Jan. 12, 1893.—Parties interested in the projected electric railroad between Chicago and St. Louis appeared before the Senate Committee on Commerce yesterday and endeavored to show that the government should permit them to import necessary construction material free of duty in consideration of building a pioneer line which shall whisk passengers and mail to and from Chicago and St. Louis at a speed of over a hundred miles an hour.

Wellington Adams and others represented the interests of the company, while the General Electric Company was represented by Eugene H. Lewis, of New York, as counsel Mr. Adams made a strong argument for the project. He said that the company was hampered in its operations by the hostility of the General Electric Company, against which he had brought suit for infringement of patents relating to motors, and there was reason to doubt whether the necessary electric machinery could be built in this country in time to have the road in operation during the World's Columbian Exposition.

Mr. Lewis opposed the bill. He saw no reason for the special exemption to be granted the Chicago and St. Louis Electric Railroad, as his company could and did manufacture electrical goods as well and as cheaply as any concern in any other country, in proof of which he asserted that they were supplying the plant for 18 electric roads building in Europe. He questioned the honesty of purpose of the new company, which, he said, never intended to really build a railroad, and he asserted that they had approached the General Electric Company with an offer to pay for electric plant with stock and bonds.

This statement led to some sharp sparring between the parties present, in which pointed references were made to the existence of a great trust in electrical manufactures, and finally Mr. Lewis admitted that other electric roads had made like propositions, which had been accepted. The committee took the bill under consideration.

FIGURES OF STREET RAILWAY TRAVEL IN BROOKLYN.

THE population of Brooklyn this year has not increased any more than in previous years, and the elevated railway service has been extended, but, nevertheless, the surface roads carried during 1892 over 15,000,000 more passengers than they did in 1891. The Brooklyn City Road headed the list with 78,500,000 passengers, an increase of 4,800,000. The Atlantic Avenue Company came next with 16,249,080, but its increase was 6,200,000, and its percentage very much greater than that of the larger road. This remarkable increase in travel in one year was undoubtedly the reason why the new syndicate that has purchased the road was willing to pay $250 a share for its stock.

These figures ought to show the fallacy of the old idea that the building of the elevated roads would ruin the surface roads. The latter have gone on doing more business than ever since the former were completed, and it really seems that the more roads there are the more people ride instead of walk.

This increase in the business of the surface railroads has not injured the elevated at all; in fact, the Brooklyn elevated did last year the biggest business of any year since its organization, and, for the first time, came out of the struggle with a surplus. It carried 37,315,180 passengers, as against 34,424,708 in 1891; its gross earnings were $1,901 671.77, and its operating expenses $1,072,526.26. This left net earnings of $829,145.51, and after the interest on bonds and other fixed charges were paid, amounting to $711,089.59, there was a surplus of $118,055.92.

THE NOISE MADE BY SOME TROLLEY CARS.

A CORRESPONDENT in Baltimore calls our attention to the very unnecessary noise made by some trolley cars, and encloses the following item from a Baltimore newspaper:—

> Mr. John Henry Keene, Jr. wrote to Mayor Latrobe yesterday a formal notification of proposed legal action on account of the Central Railway Company. The cars pass the residence of Mr. Keene, corner of St. Paul and Preston streets. The letter is in part as follows:
>
> "Inasmuch as express notice is essential to maintain an action at law for the recovery of damages against municipal corporations on account of nuisances, on my own behalf, as well as that of all other persons who have suffered or hereafter may suffer special damage, I notify you as Mayor of the city of Baltimore that the Central Railway, as run and constructed from the commencement to the termination of its route and contiguous thereto, is a public and private nuisance, nothwithstanding its color or warrant of lawful authority by reason either of the license of the city ordinance or the confirmation of this license by an act of the Legislature."
>
> After discussing the legal aspects of the case Mr. Keene says: "I give you further notice that the nuisance of which I complain exceeds the extravaganzas of fiction, and equals the barbarous cruelties of the middle ages. This nuisance is not a mere visionary picture; it is a stern reality—a flesh and blood fact with color in its cheeks. It is a system of rapid transit by hissing monsters, often hurled at frightful rates of speed, thumping and bumping at every step. They ascend and descend every grade with Babylonish howls. The air rings with the shrieks of their gongs, and by day and by night a flesh-creeping saw-mill buzz, with showers of electric sparks, mark their struggling, groaning course through the highways of a densely populated city.
>
> "To picture the horrors of this nuisance requires the genius of the author of the 'Inferno,' and it affords a most significant illustration of what our Court of Appeals has called the subjection of the streets to 'extraordinary servitudes.' No sooner does one of these furies disappear than lo! another follows hard and fast upon its heels. Often two pass each other upon their double tracks, and the air for blocks around is filled with the unearthly din of their motors. What aggravates the nuisance is that the reign of terror commences at early dawn and lasts until long after the midnight hour. In consequence of the vibration and concussion of the air produced by this nuisance at every few minutes night and day, houses are shaken, doors and walls tremble, windows creak and chandeliers and glass shiver. Strong men, sick women and children are alike prostrated, their nervous systems shattered and their health undermined, notwithstanding that they have bought their houses upon the sacred trust that the city they support by taxes has the power and authority, and stands charged with the duty and obligation, of removing and preventing whatever is instrinsically a nuisance and essentially deprives the owner of premises abutting upon a highway of the enjoyment, comfort and protection of his fireside."

Though the above account, I must honestly admit, is *slightly* exaggerated, writes our correspondent, the motor's weird complaint can sometimes be heard for blocks and the effect on the nerves of even an ordinarily sensitive person is startling I assure you. To illustrate the matter take for example: A car is starting after taking a passenger aboard. The motor-man with eagle eye carefully scans the roadbed and with one hand on the brake and the other on the controller prepares to get in his deadly work. Imperceptibly the latter moves and the car starts so slowly as to suggest that it were moved by unseen spirits; and then with a lightninglike movement the controller is thrown to the full speed position. The motors roar and howl, the car trembles violently, the peripheries of the wheel become circles of light, the grinding of the wheels on the rail through insufficient tractive effect produces a sound similar to the simultaneous operation of a number of coffee mills; and thus does the electric car proceed on its way rejoicing, truly winning its name of a thunderbolt of Jove. I hope that in the future, by proper management and care it will be impossible to elicit any other expression from the people than one of praise for the *only* system of rapid transit. Our friends reveal our faults to us, and make us haste to do better in the future.

THE COST OF TRACK SPRINKLING AND CLEANING.

The question of transfers between the Central and Rapid Transit Co.'s in Peoria, Ill., has not been decided as yet. There have been several meetings between the city council and Manager Findley, of the Central. The railroad company will give transfers if the council will remove the three per cent. levy it is to receive in five years. The Central Company through Manager Findley gave recently an estimate of the cost of sprinkling the tracks, etc. His report is as follows:—

The Central R. R. Co. own 44,752 feet of double track and 6,479 feet of single track, or a total of 95,983 feet of single track. Allowing seven feet for the width to be cleaned for a single track, there would be 671,881 square feet of surface to be cleaned and swept, which is equal to 74,653 square yards. Estimating the cost for sweeping to be $1.15 per 1,000 square yards, being the price paid by the city, it would cost the railroad company $85 85 for each time the tracks were cleaned. Allow for cleaning the tracks once every week, the sum total per year would be $4,464.20.

If the city furnish the water, the cost for teams and labor to do the sprinkling would be about $15 per day. Estimating that it would be necessary to sprinkle 200 days each year, the cost per year would be $3,000; or total cost for cleaning and sprinkling each year $7,464.20.

The Rapid Transit Co., of Peoria, own 14,665 feet of single track; figured on the same basis the total cost for cleaning and sprinkling would be about $1,250 per year.

From this it would seem that the railroad company are ready to clean and sprinkle their tracks and throw in transfers, to get off the three per cent. levy. The cleaning and sprinkling to commence at once, while the levy does not begin for five years.

THE VALUE OF A SLIDING CONTACT TROLLEY.

Mr. Louis B. Van Nuys writes us from Peoria, Ill., that during a recent severe sleet storm there, the electric lines managed to run by taking the trolley wheels out of the trolley poles and letting the forks that hold them slide along the wire instead!

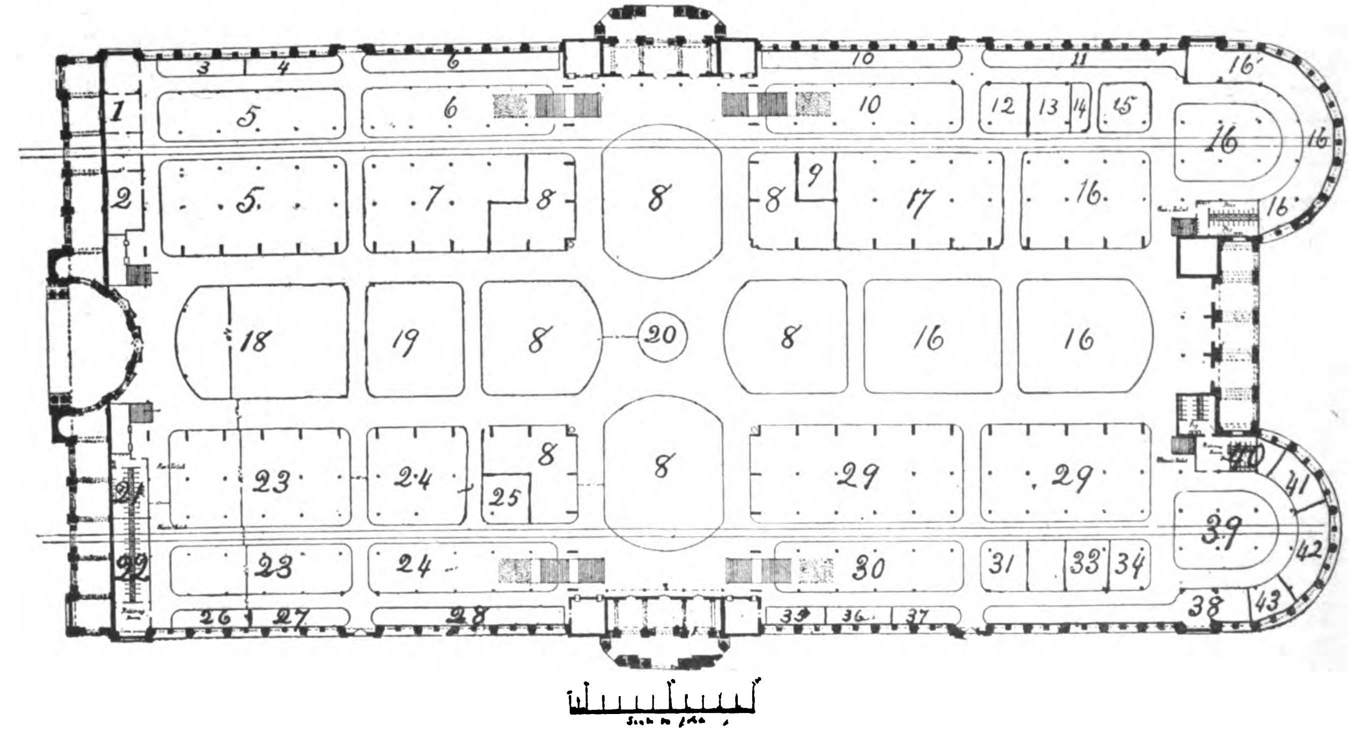
ELECTRIC RAILWAY GROWTH.

During last year the number of electric railways increased from 385 to 469, the capital stock from $155,087,973 to $205,870,000, and the mileage from 3,916 to 5,446 miles.

WORLD'S FAIR DEPARTMENT.

ALLOTTING SPACE IN ELECTRICITY BUILDING.

We show herewith plans of the ground floor and galleries of Electricity Building, with the names of the exhibitors to whom space has been allotted. The numbers on the plans correspond with the references at the foot, and it will thus be easy to understand the disposition of the exhibits.



1. Crocker Wheeler Electric Co.
2. Jenney Electric Motor Co.
3. Hanson & Van Winkle.
4. Germania Electric Co.
5. { Brush Electric Co.
   Swan Lamp Co.
   Short System of Railways.
6. National Electric Co.
7. Ft. Wayne Electric Co.
8. General Electric Co.
9. Heisler Electric Co.
10. Thomson Welding Co.
11. Italy.
12. Mexico.
13. Spain.
14. Russia.
15. Belgium.
16. France.
17. England.
18. Bell Telephone Co.
19 Detroit Electrical Works.
20. Phœnix Glass Co.
21. C. & C. Motor Co.
22. Sperry Elec. Mining Machine Co.
23. Western Electric Co.
24. Westinghouse Electric Co
25. Excelsior Electric Co
26. La Roche Electric Co.
27. Hornell Iron Works.
28. Eddy Electric Co.
29. Germany.
30. Electric Forging Co.
31. Belknap Motor Co.
32. (Not assigned).
33. Arnold Electric Co.
34. A. C. Mather.
35. Schieren Belting Co.
36. Munson Belting Co.
37. Page Belting Co.
38. The E. S. Greely & Co.
39. N. Y. Insulated Wire Co.
40. Zucker-Leavitt Chemical Co.
41. Riker Motor Co.
42. Perkins Lamp Co.
43. Akron Electric Co.

The Allotment of Space, Ground Floor, Electricity Building, World's Fair.

We print also below, the revised rules and regulations for exhibitors now adopted and put in force by the Department of Electricity.

RULES DEPARTMENT OF ELECTRICITY.

Rule 1.—Applicants for space in this Department are requested to furnish the following information as nearly as possible:

First. A drawing to the scale of ¼ inch to the foot, showing size of space desired and general distribution of articles to be exhibited, also aisles (if any among exhibits. Express length, breadth, etc., in feet and inches.

Second. State whether current for motors, lamps, or other devices is required, specifying quantity and potential in volts and amperes.

Third. If power for operating machinery is required, state number of horse-power desired.

The above information is absolutely necessary for the proper allotment of space.

Rule 2.—Applicants accepting space must agree to occupy it in accordance with the rules and regulations, and are requested to give earliest possible notice if they decide not to exhibit. Whenever circumstances will admit, exhibitors are requested to install exhibits in glass cases.

Rule 3.—No exhibitor can make exhibits in other than his own space without obtaining the written permission to do so from the Chief of the Department.

Rule 4.—No exhibitor will be allowed to arrange his exhibit in a way to occasion inconvenience or affect the display of other exhibitors.

Rule 5.—The floor of the Electrical Building is designed to sustain a weight of 150 pounds per square foot. Any exhibit requiring an extra support, in the judgment of the Chief of the Department, must be furnished with satisfactory support or foundation at exhibitor's expense.

Rule 6.—All platforms, railings, counters, signs, partitions and showcases must be erected at exhibitor's expense and shall not exceed dimensions given below. All designs for the above with location of same in exhibitor's space must be submitted to the Chief of the Department for his written approval before installation is begun.

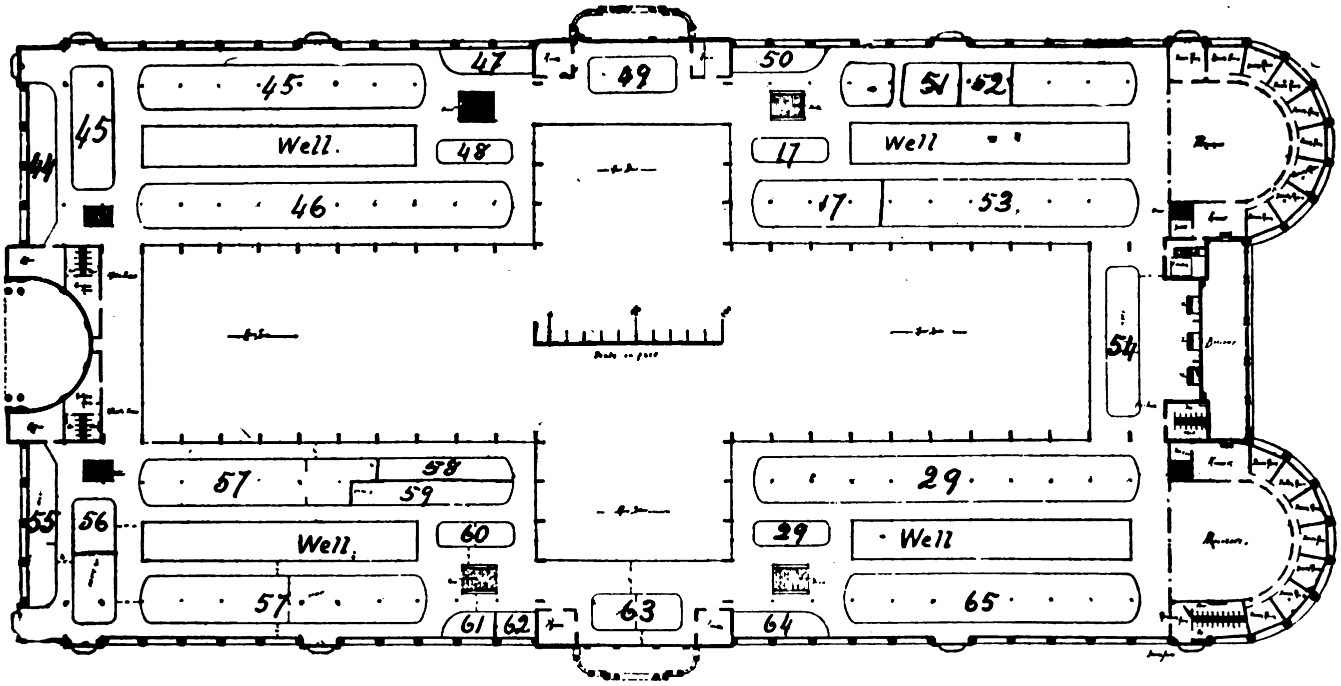
Showcases shall not be higher than 15 feet above the floor of the main aisles.

Counters shall not be higher than 2 feet 10 inches above the floor of the main aisles.

Railings may be erected, but must be of a uniform height of 2 feet 6 inches, and subject to the approval of the Chief, as in *Rule* 8.

Platforms will be allowed only in certain parts of the building. All exhibitors wishing platforms to cover their space must build them to a uniform height of 8 inches.

Partitions will be allowed only in certain parts of the building, and in all cases must not exceed 15 feet in height, and must be approved in writing by the Chief of the Department before their erection is begun.



44. E. Berliner.
45. Miscellaneous.
46. Electrical Apparatus.
47. Lafferty & Holmes.
48. McIntosh Battery Co.
49. Dayton Fan & Motor Co.
50. Elisha Gray.
51. Austria.
52. Italy.
53. Canada.
54. Electrical Supply Co.
55. Electric Specialties.
56. Weston Elect. Instrument Co.
57. Wire Exhibits.
58. Detroit Electrical Works.
59. Central Electric Co.
60. Gamewell Fire Alarm.
61. Washburn & Moen.
62. American Storage Battery Co.
63. Queen & Co.
64. Western Union Telegraph Co.
65. Testing Instruments.

The Allotment of Space, Galleries, Electricity Building, World's Fair.

Signs must be ornamental in character, and designs for same must be submitted to the Chief of the Department for his written approval. No signs will be allowed to extend beyond the limits of the exhibitor's space, nor will signs of muslin, linen, canvas or paper be accepted. The Chief of the Department reserves the right to remove any signs that may be objectionable.

Rule 7.—All exhibits of machinery in motion must be protected by ornamental railing of a uniform height of 2 feet 6 inches, and all designs for railings must be submitted to the Chief of the Department for his written approval.

Rule 8.—No fire will be allowed in the Electrical Building except by the written permission of the Chief of the Department; oils and inflammable material will be allowed only in quantities sufficient for one day's use; suitable storage will be provided for the same.

Rule 9.—Exhibitors requiring power in the Electrical Building will have to furnish the necessary countershafting, pulleys, hangers, etc., at their own expense. Electric motors only will be allowed for moving machinery in this building, and must be furnished at the expense of the exhibitor.

Shafting and motors will be under the care of the exhibitor requiring them, but can be erected only on receipt of a permit from the Chief of the Department. Exhibitors must arrange their exhibits in such a manner as to require a minimum amount of shafting by using motors connected or belted to their machinery direct.

Rule 10.—Exhibitors may employ watchmen to take care of their machinery and exhibits at night, but such watchmen will be subject to the approval of the Chief of the Department.

Rule 11.—Exhibitors will be required to have their space clean, and all rubbish swept into the aisles within one hour after the close of the Exposition at night. In cases where this rule is not complied with the work will be done by the Department and charged to the exhibitor. No sweeping will be allowed during the hours when the Exposition is open.

Rule 12.—The distribution of cards, circulars, pamphlets or samples about the building or its vicinity, will not be permitted under any circumstances. Exhibitors can distribute such articles only from their own space, but will not be allowed to solicit their acceptance.

Rule 13.—Exhibitors will be required to attach to each exhibit a printed or type-written description in the English language, of the use and operation of the object exhibited for the information of the public.

Rule 14.—Exhibitors or their agents will be furnished by the department with duplicate cards, upon which must be the name and description and the catalogue number of each article entered for exhibition. These will be countersigned on receipt of articles into the Exposition. One of these cards shall be conspicuously attached to the article described, the other to be retained by the exhibitor to serve as his order for the article at the close of the Exposition.

MISCELLANEOUS.

AN IDEAL GUBERNATORIAL CANDIDATE.

Few men in the field of mechanical engineering are better known to electrical engineers than Mr. G. C. Sims, of the Armington & Sims Engine Co., of Providence, and chairman of the Electrical Committee of the National Commission on the World's Fair. They will find much to approve in the following from the *Boston Herald*, on the Rhode Island governorship:

At present, the Democrats are not talking much about their gubernatorial candidate. But among the thinkers it has been suggested that, if the party wishes to win on a popular vote, it can do so by nominating Hon. Gardiner C. Sims.

Mr. Sims has heretofore declined to take an active part in politics. Time and again have honors been proffered him; but he has invariably said that his business engagements were such that he could not spare the time the duties of office would demand. This is a time, however, it is said by his friends, when he should make a sacrifice, for he can just as surely be elected as the day of election rolls around. He would command the entire independent vote of the state. The independent press of the state would give him hearty support. The Democratic party would indorse him to a man, and there would be a good many Republicans, who admire the man for his sterling character, who would gladly vote for him.

Gardiner C. Sims' name is synonymous with positive good faith, honor, business integrity and everything that is above board and goes to make up a thoroughly reputable citizen. He is an ideal candidate, and he would give to the state an intelligent, progressive and aggressive administration. He is one of the foremost members of the Commercial Club, the organization which is doing so much good in awakening public interest in the affairs which go to make up a good government and a live community.

INSULATION RESISTANCE OF COTTON AND SILK-COVERED-WIRES.—A CORRECTION.

Through an error of the engraver the designations of the curves in Fig. 7 of the above article appearing in the Engineer of Dec. 28, 1892, were transposed. As the text clearly shows, the upper curve should be marked "Double Cotton Shellacked," and the lower, "Single Cotton Shellacked." Also in the line immediately above the Fig. 8 on p. 615, in the same article, the infinity sign ∞ was inadvertently turned up by the printer so as to read as the figure 8.

THE UTILIZATION OF NIAGARA.[1]—I.

BY PROF. GEORGE FORBES, F.R.S.

THE situation of Niagara Falls is peculiarly favorable, both from the engineering and commercial point of view. As a source of water power, it stands almost unrivaled, not only on account of the enormous volume of water, and the considerable height of its fall, but also on account of the unvarying volume which is continually flowing. From a commercial point of view the situation of the Falls is perhaps unique, and the originators of this enterprise can find much to support their views—that they are entitled to look forward to the prospect of founding, in the immediate vicinity of the Falls, a manufacturing town greater than any which exists in the United States. This sounds a somewhat too enthusiastic view of the matter to those who are accustomed only to a comparatively slow rate of progress in European affairs. But when one sees a town like Minneapolis springing up to its present proportions in the course of a few decades, due to the development of some fifteen thousand h. p., used by the water-wheels there; and the industries which have sprung up to utilize the water-power developed at Holyoke, Mass., one can imagine the effect that the utilization of Niagara Falls will have on the prosperity of the locality. The great developments of electrical industry, either from a manufacturing, mining, or agricultural point of view are in the far West; and the enormous group of navigable lakes form a natural highway for the transport of raw products, most of which require the expenditure of power to convert them into articles of commerce. Niagara Falls being situated at the eastern extremity of these lakes, which is the end nearest to the consumers, they evidently occupy an advantageous position. Three principal lines of railway pass in the immediate vicinity of the land owned by the company which is developing the power of Niagara Falls, and a terminal railway has already been built by them to connect the different parts of their property with these three lines of railway. The Erie Canal also passes from this point to the Hudson River and thence to New York, and Niagara Falls being actually on the frontier of Canada open up the whole of that country to commerce. Thus we see that both from an engineering and commercial point of view this situation is peculiarly favorable to a rapid development.

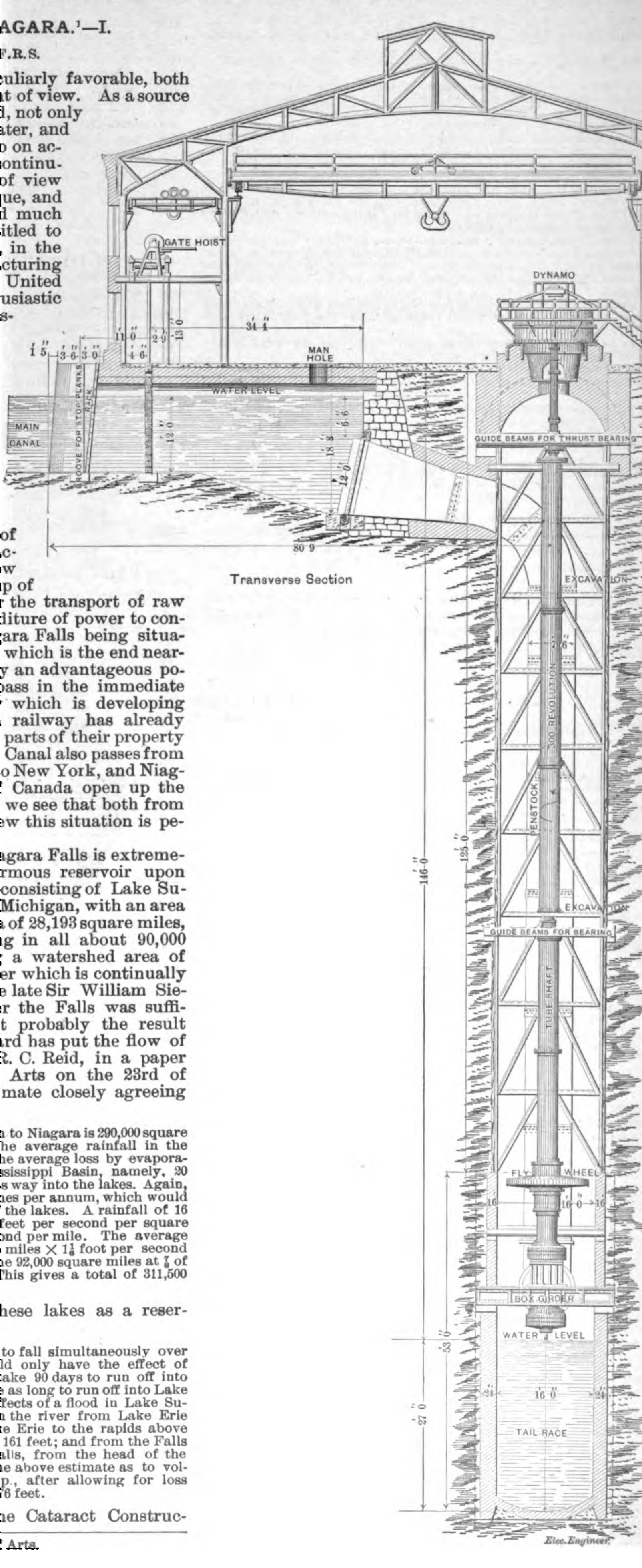
The reason why the flow of water at Niagara Falls is extremely regular, is that we have such an enormous reservoir upon which to draw for our supply, this reservoir consisting of Lake Superior, with an area of 33,517 square miles, Michigan, with an area of 24,200 square miles, Huron, with an area of 28,193 square miles, and Erie, with an area of 11,574 miles, being in all about 90,000 square miles of reservoir surface, draining a watershed area of 2,411,235 square miles. The volume of water which is continually flowing has been variously estimated. The late Sir William Siemens considered that the flow of water over the Falls was sufficient to develop 16,000,000 of h. p., but probably the result is considerably less. The Lake Survey Board has put the flow of water at 265,000 cubic feet a second. Mr. R. C. Reid, in a paper read before the Royal Scottish Society of Arts on the 23rd of March, 1885, has made an independent estimate closely agreeing with this. He says:—

> The drainage area of the whole Lake Basin down to Niagara is 290,000 square miles, and of that there is of lake surface 92,000. The average rainfall in the lake district may be taken at 36 inches, and taking the average loss by evaporation and absorption at the figures given for the Mississippi Basin, namely, 20 inches, there will be 16 inches of rainfall that finds its way into the lakes. Again, on the surface of still water the evaporation is 24 inches per annum, which would leave 12 inches of rainfall collected on the surface of the lakes. A rainfall of 16 inches is very nearly equal to an average flow of $1\frac{1}{8}$ feet per second per square mile, while 12 inches would equal $\frac{7}{8}$ of a foot per second per mile. The average flow will therefore be—from the land, 198,000 square miles × $1\frac{1}{8}$ foot per second per mile, giving 231,000 feet per second; and from the 92,000 square miles at $\frac{7}{8}$ of a foot per second per mile, 80,500 feet per second. This gives a total of 311,500 cubic feet per second.

As an example of the effectiveness of these lakes as a reservoir, Mr. Reid says:—

> If a rainfall of three inches in the 24 hours were to fall simultaneously over the vast region draining into Lake Superior, it would only have the effect of raising the lake nine inches. In that case, it would take 90 days to run off into Lake Huron, which, with Lake Michigan, would take as long to run off into Lake Erie; so that it would take six months for the full effects of a flood in Lake Superior to be spent at Niagara Falls. The total fall in the river from Lake Erie to Lake Ontario is 329 feet, divided as follows:—Lake Erie to the rapids above the Falls, 15 feet; in the rapids, 55 feet: at the Falls, 161 feet; and from the Falls to Lake Ontario, 98 feet. The total power in the Falls, from the head of the upper rapids to the whirlpool rapids, according to the above estimate as to volume of water, is 9,400,000 h. p., or about 7,000,000 h. p., after allowing for loss of efficiency in the turbines. This is with a fall of 276 feet.

The actual fall which will be used by the Cataract Construc-



Transverse Section

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[1] Abstract of a paper read before the Society of Arts.

tion Company is only half of this, or 140 feet, and consequently the power which they would be capable of developing, if they utilized the whole of the Falls, would be about 3,500,000 horse power effective.

There are two falls at Niagara—one called the Horseshoe Fall and the other the American Fall. The former has a length of 812 yards, and the latter of 325 yards, but about $\frac{9}{10}$ths of the water passes over the Horseshoe Falls, and only about $\frac{1}{10}$th over the American Falls. It might be supposed then, that when 100,000 or 200,000 h. p. are taken from the American side of the river for conversion into power, there would be a material diminution in the volume passing over the American Falls; but from a special investigation made by Mr. Bogart, it appears pretty certain that the deficiency of water will be made up by the water from the other side of the river, before the latter has been divided between the two falls by Goat Island.

The idea of utilizing the Falls of Niagara is a very old one, but it is only of late years that the application of electricity has been sufficiently developed to make the problem of distributing the power capable of being worked out on a paying financial basis. The power of the Falls, has, however, been utilized to a certain limited extent for many years past. A canal has been cut from the river above the falls on the American side, skirting the side of Niagara Falls city, and ending at the cliffs about half a mile below the American Falls. At this point a few acres of land are given up to mills where turbines are placed, and the water is discharged from the face of the cliff after having utilized only a very small proportion of the fall available. When the Cataract Construction Company undertook to further develop the wasted power, an extension of this plan of using a canal was open to many objections. There was a difficulty in getting rights of way, and there was also a difficulty in getting a suitable tract of land on the face of the cliffs for developing a manufacturing city. Moreover, by having the manufacturing city which is to be developed a mile or two above the Falls, it would not interfere in the same way with the natural beauties of the place. It was consequently resolved to develop the new method which has now been carried out. About a mile and a half above the American Fall a canal has been dug out 500 feet wide, and 1,500 feet long, with a depth of 12 feet. Along the edge of this canal, wheel pits are being dug 160 feet deep, at the bottom of which turbines will be placed. The water is admitted to the penstocks by lateral passages or head-races which can be closed by gates. After the water has exerted its power upon the turbines, it flows into a tunnel, with a grade of seven feet per 1,000, which carries it away a distance of 6,700 feet, under the city of Niagara Falls, and the water is discharged in the chasm below the Falls, just below the suspension bridge.

The most important piece of work was the cutting of the tunnel. The rocks through which this passes consist of limestone and shale. It was hoped at first, that, by driving the tunnel altogether through the limestone, no lining would be necessary. Specimens of the limestone were forwarded to experts, and from the reports of these gentlemen, there seemed little doubt that these expectations would be realized. But at the very commencement of the work it became apparent that the character of the rock was such that exposure to the air deteriorated it, and it was not possible to proceed without lining the tunnel. This involved considerable extra expense, but it enabled us to bring out the mouth of the tunnel at a lower level—that is to say, in the shale. The extra cost of lining this tunnel with four courses of bricks was very considerable, but it is to be hoped that by so doing, a permanent structure has been provided which will not give trouble in the future. At the mouth of the tunnel, a lining is provided on the invert and sides made of cast-iron plates. The rock excavation had an average height of 26 feet, and was effected on three different benches. The top bench, nine feet high, to the top arch has always extended ahead of the second bench, eight feet high. When these were completed, the bottom bench was commenced. The tunnel is shaped something like a horseshoe. It may be taken as being 19 feet wide by 21 feet high inside the brickwork, and has a cross sectional area of 386 square feet over its entire length. Three shafts were used in construction, one on the face of the cliff at the mouth of the tunnel; another called Shaft No. 1, 2,650 feet from the mouth, with a depth of 206 feet, and a section 10 feet by 20; while shaft No. 2, at 5,200 feet from the mouth, is the same size, and is 196 feet deep.

The rough arch cut in the rock was lined with timber. Then four courses of brick were built inside to form the arch, and the space between the timber and brick was filled at the top with rubble, and at the lower parts of the arch with rubble and cement.

The engineering work of importance, next to the development, was the cutting of the canal. It was found necessary to line this canal with solid masonry. Apertures are left, at definite points, to admit water for the head-races into the penstocks for the turbines. In order to dig out this canal it was necessary to make a cofferdam at its outlet, to prevent the works from being flooded by the river. This cofferdam forms only a part of a system of cofferdams, which already extend along a considerable distance on the face of the river. These cofferdams form the boundary of a large tract of land which has been reclaimed from the river. The material used in their construction, and in filling up the reclaimed space, was made of the material taken out of the tunnel. In this manner 30 acres of reclaimed land have been reserved for the Niagara Falls Paper Company, who have already constructed enormous factories for the manufacture of paper from wood pulp. This company utilizes the water power direct, and leases from the Cataract Construction Company the right to use the tunnel as a tail-race. It has sunk its own wheel pit, and is putting in its own turbines, to the extent of 6,000 h. p.

The Cataract Construction Company has already sunk a shaft sufficient to accomodate three of the 5,000 h. p. turbines which are to be used for the work of distributing light and power. Considerable difficulty was met with in sinking this shaft, by the influx of water through a seam at a depth of about 30 feet below the surface. These difficulties have never interfered with the progress of the work, which has now been successfully carried out. The turbines which are to be used are of 5,000 h. p., revolving at 250 revolutions per minute, of the Girard or impulse type, with a regulator for adjusting the flow of water. Each turbine is double. Attached to the shafts of the turbines are vertical shafts, extending to the surface of the ground, and, on the top of these shafts, the dynamos are to be mounted, which will transmit electricity, for light and power purposes, to the surrounding districts and to Buffalo. The turbines are from the designs of Messrs. Faesch and Piccard, of Geneva, who transmitted the working drawings to America; and the contract for these turbines has now been given out to the I. P. Morris Company, of Philadelphia, two turbines having been ordered in the first instance. Twenty of these will be required to utilize the full capacity of the tunnel, which is 100,000 h. p. (See diagram on page 64.)

ALTERNATE CURRENTS OF HIGH POTENTIAL AND HIGH FREQUENCY.—II.

BY NIKOLA TESLA.

In operating an induction coil with these rapidly alternating currents, it is astonishing to note, for the first time, the great importance of the relation of capacity, self-induction, and frequency as regards the general result. The combination of these elements produces many curious effects. For instance, two metal plates are connected to the terminals and set at a small distance, so that an arc is formed between them. This arc *prevents* a strong current to flow through the coil. If the arc be interrupted by the interposition of a glass plate, the capacity of the condenser obtained counteracts the self-induction, and a stronger current is made to pass. The effects of capacity are the most striking, for in these experiments, since the self-induction, and frequency both are high, the critical capacity is very small, and need be but slightly varied to produce a very considerable change. The experimenter brings his body in contact with the terminals of the secondary of the coil, or attaches to one or both terminals insulated bodies of very small bulk, such as exhausted bulbs, and he produces a considerable rise or fall of potential on the secondary, and greatly affects the flow of the current through the primary coil.

In many of the phenomena observed, the presence of the air, or, generally speaking, of a medium of a gaseous nature (using this term not to imply specific properties, but as contradistinction to homogeneity or perfect continuity) plays an important part, as it allows energy to be dissipated by molecular impact or bombardment. The action is thus explained :—

When an insulated body connected to a terminal of the coil is suddenly charged to a high potential, it acts inductively upon the surrounding air, or whatever gaseous medium there might be. The molecules or atoms which are near it are, of course, more attracted, and move through a greater distance than the further ones. When the nearest molecules strike the body they are repelled, and collisions occur at all distances within the inductive distances. It is now clear that, if the potential be steady, but little loss of energy can be caused in this way, for the molecules which are nearest to the body having had an additional charge imparted to them by contact, and not attracted until they have parted, if not with all, at least with most of the additional charge, which can be accomplished only after a great many collisions. This is inferred from the fact that with a steady potential there is but little loss in dry air. When the potential, instead of being steady, is alternating, the conditions are entirely different. In this case a rhythmical bombardment occurs, no matter whether the molecules after coming in contact with the body lose the imparted charge or not, and, what is more, if the charge is not lost, the impacts are only the more violent. Still, if the frequency of the impulses be very small, the loss caused by the impacts and collisions would not be serious unless the potential were excessive. But when extremely high frequencies and more or less high potentials are used, the loss may be very great. The total energy lost per unit of time is proportionate to the product of the number of impacts per second, or the frequency and the energy lost in each impact. But the energy of an impact must be proportionate to the square of the electric density of the body, on the assumption that the charge imparted to the molecule is proportionate to that density. It is concluded from this that the total energy lost must be proportionate to the product of the frequency and the square of the electric density; but this law needs experimental confirmation. Assuming the preceding considerations to be true, then, by rapidly alternating the potential of a body immersed in an insulating gaseous medium, any amount of energy may be dissipated into space. Most of that energy, then, is not dissipated in the form of long ether waves, propagated to considerable distance, as is thought most generally, but is consumed in impact and collisional losses—that is, heat vibrations—on the surface and in the vicinity of the body. To reduce the dissipation it is necessary to work with a small electric density—the smaller the higher the frequency.

The behavior of a gaseous medium under such rapid alternations of potential makes it appear plausible that electrostatic disturbances of the earth, produced by cosmic events, may have great influence upon the meteorological conditions. When such disturbances occur, both the frequency of the vibrations of the charge and the potential are in all probability excessive, and the energy converted into heat may be considerable. Since the density must be unevenly distributed, either in consequence of the irregularity of the earth's surface, or on account of the condition of the atmosphere in various places, the effect produced would accordingly vary from place to place. Considerable variations in the temperature and pressure of the atmosphere may in this manner be caused at any point of the surface of the earth. The variations may be gradual or very sudden, according to the nature of the original disturbance, and may produce rain and storms, or locally modify the weather in any way.

From many experiences gathered in the course of these investigations it appears certain that in lightning discharges the air is an element of importance. For instance, during a storm a stream may form on a nail or pointed projection of a building. If lightning strikes somewhere in the neighborhood, the harmless static discharge may, in consequence of the oscillations set up, assume the character of a high frequency streamer, and the nail or projection may be brought to a high temperature by the violent impact of the air molecules. Thus, it is thought, a building may be set on fire without the lightning striking it. In like manner small metallic objects may be fused and volatilized—as frequently occurs in lightning discharges—merely because they are surrounded by air. Were they immersed in a practically continuous medium, such as oil, they would probably be safe, as the energy would have to spend itself elsewhere.

An instructive experiment having a bearing on this subject is the following:—A glass tube of an inch or so in diameter and several inches long is taken, and a platinum wire sealed into it, the wire running through the centre of the tube from end to end. The tube is exhausted to a moderate degree. If a steady current is passed through the wire it is heated uniformly in all parts and the gas in the tube is of no consequence. But if high frequency discharges are directed through the wire, it is heated more on the ends than in the middle portion, and if the frequency, or rate of charge, is high enough, the wire might as well be cut in the middle as not, for most of the heating on the ends is due to the rarefied gas. Here the gas might only act as a conductor of no impedance, diverting the current from the wire as the impedance of the latter is enormously increased, and merely heating the ends of the wire by reason of their resistance to the passage of the discharge. But it is not at all necessary that the gas in the tube should be conducting; it might be at an extremely low pressure, still the ends of the wire would be heated; as, however, is ascertained by experience, only the two ends would in such case not be electrically connected through the gaseous medium. Now what with these frequencies and potentials occurs in an exhausted tube, occurs in the lightning discharge at ordinary pressure.

From the facility with which any amount of energy may be carried off through a gas, it is concluded that the best way to render harmless a lightning discharge is to afford it in some way a passage through a volume of gas.

The recognition of some of the above facts has a bearing upon far-reaching scientific investigations in which extremely high frequencies and potentials are used. In such cases the air is an important factor to be considered. So, for instance, if two wires are attached to the terminals of the coil, and streamers issue from them, there is dissipation of energy in the form of heat and light, and the wires behave like a condenser of larger capacity. If the wires be immersed in oil, the dissipation of energy is prevented, or at least reduced, and the apparent capacity is diminished. The action of the air would seem to make it very difficult to tell, from the measured or computed capacity of a condenser in which the air is acted upon, its actual capacity or vibration period, especially if the condenser is of very small surface and is charged to a very high potential. As many important results are dependent upon the correctness of the estimation of the vibration period, this subject demands the most careful scrutiny of other investigators.

In Leyden jars the loss due to the presence of air is comparatively small, principally on account of the great surface of the coatings and the small external action, but if there are streamers on the top, the loss may be considerable, and the period of vibration is affected. In a resonator, the density is small, but the frequency is extreme, and may introduce a considerable error. It appears certain, at any rate, that the periods of vibration of a charged body in a gaseous and in a continuous medium, such as oil, are different, on account of the action of the former, as explained.

Another fact recognized, which is of some consequence, is, that in similar investigations the general considerations of static screening are not applicable when a gaseous medium is present. This is evident from the following experiment: A short and wide glass tube is taken and covered with a substantial coating of bronze, barely allowing the light to shine a little through. The tube is highly exhausted and suspended on a metallic clasp from the end of a wire. When the wire is connected with one of the terminals of the coil, the gas inside of the tube is lighted in spite of the metal coating. Here the metal evidently does not screen the gas inside as it ought to, even if it be very thin and poorly conducting. Yet, in a condition of rest, the metal coating, however thin, screens the inside perfectly.

PROVISIONAL PROGRAMME FOR THE INTERNATIONAL ELECTRICAL CONGRESS OF 1893.

THE General Congress Committee of the American Institute of Electrical Engineers has just received the report of its sub-committee, embodying a provisional programme for the conduct and work of the Congress, to be held in Chicago during this year.

The sub-committee consisting of Mr. Carl Hering, chairman; Prof. Wm. A. Anthony and Mr. A. E. Kennelly, made the following recommendations, in the course of an admirable report:—

RECOMMENDATIONS.

(1.) *Ratification of the adoption of units, terms and definitions made by previous International Electrical Congresses.*

(2.) *Defining and adopting practical units for measuring and designating the measurements of the following quantities: Magneto-motive force; magnetic flux; magnetic intensity; magnetic reluctance; electric conductivity; illumination.*

Your Committee recommends the following:

The value of the practical unit of magneto-motive force to be one-tenth of the absolute unit, that is, equal to $\frac{1}{4\pi}$ ampere turn.

The value of the practical unit of magnetic flux to be 10^8 absolute units or lines.

The value of the practical unit of magnetic intensity to be 10^8 absolute units, that is, 10^8 lines per square centimetre.

The value of the practical unit of reluctance to be 10^{-9} absolute units.

The value of the practical unit of electrical conductivity to be 10^{-9} absolute units, that is, to the reciprocal of the ohm. This makes it equal to the unit proposed some time ago and known to some extent by the name of "mho." It should be given this value in order that it correspond with the already adopted unit.

The value of the practical unit of illumination to be a violle at the distance of one metre. The violle is the unit of light or candle power already established; by making the distance a metre the practical unit will be approximately equal to the carcel-metre, the the foot-candle or to 10 metre-candles or metre-kerzen, all three of which units are already in use to some extent.

It has been announced that a proposition will be made at this Congress to change the values of some of the practical units which have been adopted by previous Congresses and are already in universal use. Among these are the ampere and the farad. It is urgently recommended by the Committee that such changes should not be favored, since they would necessarily be followed by great confusion and would of necessity have to be accompanied by some change in these well established names in order to distinguish these new units from those now existing.

(3.) *Adopting names for the following practical units: Magneto-motive force; magnetic flux; magnetic intensity; magnetic reluctance; inductance; electrical conductivity; illumination.*

The following names are suggested for these units:

For the practical unit of magneto-motive force, the name "gilbert."

For the practical unit for magnetic flux, the name "weber." This term was formerly applied to a unit of current, but its use in this sense was so limited, and it has been abandoned for so long a time that no confusion would be likely to arise.

For the practical unit of magnetic intensity, the name "gauss." This name has already come into use to such an extent that objections to it will not be likely to arise.

For the practical unit of magnetic reluctance, the name "oersted."

For the practical unit of inductance, the name "henry." This name has already come into use quite extensively and it would therefore be very undesirable to change it. The value of this unit has already been fixed as equal to 10^9 absolute units or nearly to the length of an earth's quadrant.

For the practical unit of electrical conductivity, equal to the reciprocal of the ohm, the name "mho." This name has been in use for some time and is already well known. It is thought better to recommend it rather than to select and introduce a new name.

For the practical unit of illumination, the name "lux." This name has been in use for some time past for the foot-candle. If the unit violle-metre is adopted, the name "lux" could be given to it without materially changing the meaning, as the violle-metre is approximately equal to the foot-candle. One of the compound terms "foot-candle," "metre-candle" or "metre-carcel" might perhaps be preferable to "lux" as they explain themselves.

It has been suggested to name the units "kilowatt-hour" and "ampere-hour." The committee, however, recommends that inasmuch as these terms explain themselves, and are not longer than some others in use, to give them special names would burden a system of nomenclature unnecessarily.

(4.) *Defining and adopting modes of embodying the following principal units of measurement in concrete standards capable of being readily reproduced, and adopting names for them or for the theoretical units by which they can be distinguished from each other:—Ampere, ohm, volt, watt, standard candle.*

The following definitions of these units are recommended:

An ampere shall be that unvarying current, which, when passed through a solution of nitrate of silver in water, in accordance with the specifications recommended in the recent report to the British Board of Trade, deposits silver at the rate of 0.001118 of a gramme per second.

An ohm shall be the resistance offered by a column of mercury at the temperature of melting ice 14.4521 grammes in mass, of a constant cross-sectional area and of a length of 106.3 centimetres.

A volt shall be the product of this ampere and this ohm.

A watt shall be the product of the square of this ampere and this ohm.

The other units such as the coulomb, the farad, and the joule, shall be taken as derivatives in terms of this ampere and this ohm.

In order to create as little confusion as possible by the introduction of this set of units which are to become the universal standards, and in order to distinguish them readily from the true, theoretical or abstract units defined in terms of the absolute units, it is recommended to call the former simply "amperes," "ohms," "volts," etc., or more specifically "standard amperes," "standard ohms," etc., and to call the theoretical units "true amperes," "true ohms," etc. The latter term has already come into use in this sense.

The unit of resistance known as the B. A. unit, shall be taken as equal to 0.9866 of this ohm.

The E. M. F. of a Clark cell at 15° C., prepared in accordance with the specification recommended in the recent report to the British Board of Trade shall be taken as not different from 1.434 of these volts by more than one part in 1,000. The co-efficient of temperature shall be taken as.....................

The standard candle shall be taken as equal to the light from a lamp like the one that is known as the Hefner-Alteneck standard amyl acetate lamp, which is to be defined by its dimensions and the height of the flame, the dimensions being such that the light shall be equal to the "bougie-decimale," the practical unit adopted at the Paris Congress of 1889.

It has been suggested also that a universal wire gauge be defined and adopted, but the committee recommends that no action be taken by this Congress in this matter, as it is not likely that any one scale would ever be universally adopted by manufacturers, even if defined and adopted by a Congress. The universal introduction of the metric system and the designation of wires by their diameters in millimetres, is thought to be the only satisfactory solution of this question for international work.

(5). *Adopting an international system of notation and conventional symbols, for designating different quantities.*

The system suggested to the last Congress by Mr. E. Hospitalier, of Paris, is recommended by your committee, although doubtless some changes will be found desirable.

(6). *Defining the following terms:—Impressed* E. M. F.*: inductivity; inductance; reluctivity; Matthiessen's standard; north and south pole.*

The following definitions are suggested:

The impressed E. M. F. is the ratio of the total activity in an electrically conducting circuit to its instantaneous current-strength.

The inductivity at any point in an isotropic medium is the ratio, added to unity, of four π times the intensity of magnetization there existing, to the magnetizing flux-density. Inductivity is synonymous with "permeability." The electromagnetic dimensional formula is $L^0\ M^0\ T^0$; the conventional symbol is μ.

Inductance.—(*a*) Self-inductance is the ratio of the total magnetic induction linked with and established by an electric current, to the uniform strength of the same. The inductance of a conducting circuit is constant when its environing medium has constant inductivity. (*b*) The mutual inductance of one electric circuit upon another is the ratio of the total magnetic induction linked with the second, due to a uniform current in the first, to the strength of that current. The mutual inductance between two electric circuits is reciprocally equal when the environing medium has constant inductivity. The electromagnetic dimensional formula is $L^1\ M^0\ T^0$. The absolute unit is one centimetre; the practical unit, one henry.

The reluctivity of a medium at any point is the volume differential of the reluctance thereat. Simple definition: Reluctivity is the reluctance per unit volume. The electromagnetic dimensional formula is $L^0\ M^0\ T^0$. The absolute unit is one C. G. S. unit of reluctance per cubic centimetre; the proposed practical unit is one oersted per cubic centimetre.

The resistance of copper known as Matthiessen's standard shall be defined as follows:—The resistance of a soft copper wire one metre long, weighing one gramme, is 0.14365 B. A. units at 0° C. This definition is the one recommended by the Committee of the American Institute of Electrical Engineers on Matthiessen's Standard. The reasons for selecting this one are given in that report.

The north pole of a magnet shall be defined as being that one which seeks the geographic north pole, and the south pole that one which seeks the geographic south pole. This is the generally accepted definition, but it is thought desirable to formally define it.

(7.) *Defining and adopting expressions:—For alternating currents of more than one phase; for describing phenomena of alternating currents and of electromagnetic waves.*

It is recommended to adopt the following expressions: "simple" alternating current for the usual alternating currents in which there is but a single phase; "di-phase" alternating currents for two alternating currents whose phases differ in time by 90 or 270 deg.; "tri-phase" alternating currents for three alternating currents whose phases differ in time by 60 or 120 deg.; "poly-phase" alternating currents for such as have more than three phases.

For expressions for describing phenomena of alternating currents and electromagnetic waves, the committee solicits suggestions.

(8.) *Recommending the more universal use:*

Of the term "voltage" as synonymous with "difference of electrical potential" or P. D. *in place of the terms "potential," "tension" or "pressure," the use of which in this sense it is recommended to abandon.*

Of the term "transformer" instead of "converter;"

Of the term "dynamotor" for a continuous current transformer;

Of the term "continuous current" instead of "direct current;"

Of the unit of power "kilowatt" instead of "horse-power;"

Of the metric system of weights and measures and suggesting means by which its introduction will be facilitated.

Regarding the programme for carrying out this work in the most satisfactory manner to all parties, and with the least loss of time, the Committee recommends that an International Congress is the place to close, but not to open a discussion on questions about which international agreement is to be had; it is therefore urgently recommended that action be taken at once to open the discussion of such matters now, in order that expressions of opinions, and, if possible, agreements may be arrived at prior to the meeting of the Congress. To this end the committee recommends that the suggestions embodied in this report, or as many of them as you may see fit to designate, be printed and sent to all the leading electrical and physical societies and journals in this country and abroad, with a request that they aid this work by making them public, by freely discussing them, and by sending copies of such discussions and any further suggestions to the General Congress Committee of this Institute, care of the Secretary, 12 West Thirty-first street, New York City. That a sub-committee of the Institute prepare from time to time a classified summary of such discussions to be sent to the leading electrical and physical journals for publication here and abroad, and that it present a final summary of this international discussion at the Congress. This discussion ought to be closed by July 1, 1893.

It is recommended also that the Institute invite other societies to coöperate with it by appointing special committees to discuss and report to their respective societies on these international questions and to publish their conclusions in the electrical journals of their country.

It has been suggested that various committees be appointed to prepare reports on the international questions on which agreement is desired, and to submit these at the meeting of the Congress. The committee, however, believes that to postpone the discussion until the Congress is in session, would lead to no satisfactory results, as was shown at the last Congress of 1891, in Frankfort. It therefore urges that the discussion take place through the medium of the journals *prior* to the meeting of the Congress, and that the only report submitted to the Congress be a summary of such discussions.

Meetings.—Regarding the meetings of the Congress, the committee recommends that, as in the Paris Congress of 1889, the meetings be divided into (a) *General Meetings*, one at the opening and one at the closing of the Congress, which are to be devoted to the consideration of general questions and those on which agreements are desired, and to the reading of papers of a general character; (b) *Sectional Meetings* for the reading of all other papers. The following division into sections is recommended:

1. Electro physics, units, measurements, and all electrical matter of a purely scientific nature; 2. Dynamos, motors, transformers, etc.; 3. Systems, central stations, installations, lamps, etc.; 4. Electric telegraphy, telephony and signaling; 5. Electric railways; 6. Electro-chemistry, batteries, electro-metallurgy; 7. Electro-physiology, and electro-therapeutics; 8. Legal questions.

Papers.—It is suggested that specific invitations be extended by the Congress Auxiliary to prominent electrical engineers and physicists to prepare papers on specified subjects to be read and discussed at the Congress Meetings. Also, that a general invitation be extended for other papers, which are to be submitted not later than July 15, 1893, to a committee on papers appointed by the Chairman of the Congress Auxiliary; that this committee shall examine and accept or return the latter, and at its discretion shall print any or all of those accepted as well as those solicited, in form for circulation at least one week prior to the meeting at which they are to be read; that the papers shall be read in full, in abstract or by title, as that committee shall direct.

The following subjects of papers are offered as a suggestion to the Congress Auxiliary merely as a basis and not as a complete list. (Suggestions also of English Committee.)

The criterion of sensitiveness of galvanometers; or on the theory of their construction.

The working of National or Municipal Laboratories for testing meters and instruments.

The practical results and economy of the employment of accumulators in Central Station systems of supply.

On the relation between weight of copper and iron in dynamos and their output.

Nomenclature and notation of magnetic circuit—or on Standards and Units of Magnetism.

On the economic use of transformers under various conditions of supply.
Electricity meters from an European standpoint.
Electricity meters from a British standpoint.
Electricity meters from an American standpoint.
Choice of materials for standards of electrical resistance.
Nomenclature of phenomena of electromagnetic waves.
Standards for electrical measurement.
Alternating current transformers from an American standpoint.
High frequency and high potential phenomena.
Dynamo construction.

The Committee suggests that papers should be solicited by the General Congress Committee of this Institute on the work of the early electricans of this and foreign countries considered from a modern standpoint, and their importance in the development of the science of electricity, including descriptions and illustrations of models and apparatus used.

Membership.—It is suggested that the membership of the Congress be divided into delegated members and members; that the dues for each shall be $5 (five dollars); that only delegated members and members be admitted to the meetings, and be permitted to take part in the discussions; that any one shall be entitled to become a member; that delegated members shall be appointed by governments, physical and electrical societies, and shall be approved by an international committee whose decision shall be final; that questions on which international agreement is desired be decided by the delegated members, whose decisions shall be submited to the whole Congress for approval or rejection in part or in whole, but not for alteration. It is recommended that the United States Government be requested to extend a formal invitation to foreign governments and societies to send delegates to this Congress.

The General Committee by resolution adopted on Dec. 28, 1892, gives a list of subjects extending over a wide range of electrical work and upon which papers are invited, to be presented at the Congress.

A FRANCO-AUSTRALIAN PACIFIC CABLE.

As the outcome of negotiations between the French government and that of Queensland, Australia, the first link of the long talked of submarine cable, to complete the chain of telegraphic communication about the earth, is finally to be laid from the latter colony to New Caledonia.

The Queensland and New South Wales governments each guarantee the French Cable Co. $10,000 per year for 30 years, provided the French government will guarantee $40,000 for the same period, the company agreeing to lay, maintain and work the line, and sending government messages free of charge up to the extent of the guarantee. The working expenses are not to exceed $12,000 and receipts over that amount will go toward reducing the guarantee.

The Société Française des Telegraphes Sous-Marins ready to lay the succeeding links as quickly as possible, and the second section, from New Caledonia to the Fiji Islands, at once. The proposed route of the complete cable is from Queensland to New Caledonia, to Fiji, to Samoa, to the Fanning Islands, to Honolulu and thence to either San Francisco or Vancouver.

A PRACTICAL TALK ON THE INSTALLATION OF ISOLATED ELECTRIC LIGHTING PLANTS.

At the meeting of the New York Electrical Society held on Wednesday, Jan. 11, at Columbia College, Mr. Augustus Noll, general superintendent of the New York Electrical Equipment Company, delivered a most interesting discourse on the above subject.

In laying out such plants Mr. Noll considered that the first point to be determined was the size of power units to be employed. His experience had taught him that it was more desirable, where more than one machine is employed, to make the units of different sizes. Thus, if two machines were to be employed it would be found more economical to employ one machine having 40 per cent. and another 60 per cent. of the total capacity of the plant. With such an arrangement the smaller machine could economically handle the lighter load, and the full load could also be handled with high economy.

The size of the units being determined, the question of wiring next presented itself. In this department of the work Mr. Noll showed that considerable ingenuity could be exercised in selecting methods of distribution. He showed by diagrams various methods of determining central points for distribution and illustrated the various systems of wiring by the feeder system, the feeder and main to central points and the crib system. He also showed a number of methods of wiring special installation, such as depots, hotels, etc. Wherever it was possible he deemed it advantageous to run wires in recesses, as they could then, if necessary, be more easily got at and with less inconvenience to the occupants of buildings, than where they were run in the side walls. In breweries Mr. Noll deemed it advisable not to run the wires in moldings nor in tubes, and, in general, to have as few points of contact or support for the wires as possible. This was best carried out by suspending the conductors from porcelain knobs.

Mr. Noll then took up the subject of theatre lighting. The rules of the Fire Department in this city require that all switches, cut-outs, etc., that control the parts of the building accessible to the public, should be kept in a room close to the main entrance and always accessible.

In the modern theatre there are two systems of illumination. The first, the general illumination of the house, and second, the stage lighting proper. The general lighting is effected by means of lamps around the balconies, around the pillars, and near the ceiling; these lights are usually thrown off entirely when the curtain rises, and none of them as a rule can be dimmed, though each circuit can be separately controlled. The stage lighting, on the other hand, is under full control and must necessarily be so.

Mr. Noll then showed the special adaptability of the crib system of wiring to large factories in which the location of the lights is frequently changed, and which if not previously provided for in the wiring, may lead to very poor results in both the life and illuminating power of the lamps.

The lecturer laid great stress on the value of interior conduits when properly employed. They not only insured against the carelessness of plasterers, who had spoiled much good work in the past when wires were merely laid against the bare side walls, but they also excluded moisture and permitted of easy location of any trouble and of testing out. Mr. Noll did not advocate the use of the crimping tool in making joints in the tubes. In his practice he strips the brass armor off the tube back for about ⅜ of an inch, and applies to the bared end an insulating compound. When the sleeve is slipped on the entire joint is first covered with rubber tape and then with the regular linen tape. The results obtained by means of this joint were highly satisfactory.

In the discussion which followed, Prof. F. B. Crocker remarked that he agreed with Mr. Noll in the wisdom of employing units of unequal size in isolated plants, and he had advocated this method in the past.

Mr. C. O. Mailloux, speaking on the same subject, drew attention to the fact that there ought to be considered here, that objections might be, and had been, raised by the engineers in charge of plants to the multiplication of apparatus of different sizes. In a recent case coming under his notice, the objections of the engineer to the installation of units of different sizes were so strong that they could not be overcome. Mr. Mailloux while considering conduits excellent for branches, doubted whether they thoroughly fulfilled their mission when employed for feeders and mains. He considered molding better adapted for this purpose on account of the difficulty of drawing heavy wires through the conduits.

LITERATURE.

De Magnete. By William Gilbert, M. D. Translated by P. F. Mottelay; New York. *John Wiley & Sons*, li + 380 pp. 6 × 9 inches. Price, $4.00.

THE lively discussion which has been going on for the past few weeks relative to the forthcoming publication of a translation of Gilbert's "De Magnete," and of which note was made in our last issue, has drawn considerable attention to a work which, though well known to the student and amateur of early electrical literature, has nevertheless been merely a subject of curiosity and awe to the ordinary electrical reader. While the appearance of the promised translation undertaken by the Gilbert Club some years ago is still a thing of the future, we have before us the advance proofs of a translation undertaken by Mr. P. F. Mottelay, which have been kindly placed at our disposal by the publishers.

Wm. Gilbert, M. D., E. E.

To the reader in general Gilbert's great and immortal fame rests on the fact that he first subjected the magnet to rigid and systematic investigation, and deduced the fact, by masterly logic, that the earth itself was a great magnet; and again that he clearly discerned the difference between electrics and non-electrics, and showed that the nature of the attraction exerted by the electrified body was of quite a different nature from that which endowed the magnet with its power.

But these general statements which are to be found in many text-books, give the reader no idea of the many exhaustive and indeed brilliant experiments which Gilbert undertook to verify his arguments. We say brilliant, advisedly, for, considering the state of knowledge,—or rather of ignorance, and worse than ignorance,—misinformation,—at the time, Gilbert's work is indeed a monument to human intelligence.

At the very outset Gilbert lays down his method of attacking the problem taking as an example the study of geometry in which "from certain, slight and readily understood foundations" we rise "to the highest and most difficult demonstrations, whereby the ingenious mind ascends above the ether." He inveighs with vehemence against the literature on the subject which had appeared up to his time, in which so called philosophers, physicians, mathematicians and astrologers instead of seeking to verify their opinions by experiments, merely repeat the vagaries of previous writers.

Gilbert's first book goes into the details of these ancient writers, in which we find not a few curious myths with respect to the magnet. Thus among others, that when the lodestone is rubbed with garlic it does not attract iron, nor when it is in the presence of a diamond.

He then takes up the subject of the lodestone and of its general nature, and with suitable arguments concludes to use the lodestone in the form of a sphere representing the earth, also a globe. With this magnetic globe or "terrella," Gilbert, by employing a "versorum," as he calls it, that is, a small pivoted magnetic needle, shows how the inclination of the needle varies from equator to pole and changes in the same manner as that shown by a suspended needle at different latitudes of the earth's surface.

He next studies the polarity of the lodestone, for which purpose he places it in a boat and floats it in a vessel of water. This leads him to the investigation of the magnetic properties of iron itself, and he shows how wrought iron not magnetized by the lodestone attracts iron, due to the magnetism induced in it by the earth. In these experiments besides employing short magnets floated on water by being passed through pieces of cork, Gilbert also employs a rod of iron six feet in length and more than ⅛ inch in diameter, suspended by a fine strong silk thread, "twisted differently and not all in one direction." He also proves that magnetic properties exist, though weaker, both in smelted iron and in iron ore.

It is curious to note here that Gilbert distinctly recognized the nature of polarity in a magnetic body, and indeed was the first to use the term "pole." Although evidently having a comprehension of the outward effects of polarity, he does not seem to have grasped the idea of a certain molecular arrangement which modern theory assigns as the cause of polarity in magnets. Indeed, seeking to explain the cause of the attractive power of electrical bodies, he still clings to the older idea of "effluvium" and "humors." Nevertheless he shows conclusively that the attraction which excited amber exerts is quite different from that of the magnet, and it is most interesting to follow him through the upsetting of various ancient theories by the simple expedient of an actual experiment, and thus forever sustaining or overthrowing theories which had been current theretofore. To show the acute perception of the principles possessed by Gilbert we cannot help citing here two experiments. Thus he says that "moisture from steam, breath from the mouth, water thrown on the amber instantly checks the effluvium." In contradistinction to this he points out that amber "plainly attracts the body itself, in the case of a spherical drop of water *standing on a dry surface*," being drawn up into a cone.

Gilbert then enters into a discussion of the varying strength of magnets as depending upon the point at which the attracted body is placed and referring especially to the earth and the "terrella," and showing that at the poles the force is strongest. In his numerous experiments he also shows that iron when heated to a red heat loses its magnetic properties, and acquires them again, though feebly, when cool, thus demonstrating for the first time the fact upon which the modern thermo-magnetic motor is based.

The translator has evidently done his work with the greatest care. Many foot notes give the reader the results of the researches of others and throw light on many points not elaborated upon by Gilbert. The work itself is preceded by an excellent biographical memoir of Gilbert, and by the eulogistic address of Edw. Wright, Gilbert's contemporary. We reproduce here, in small facsimile the ornamentation of the title page; and the portrait of Gilbert that is to accompany the translation.

The work contains a fac-simile reproduction of all the diagrams appearing in the original, and also of the title page upon which is what is said to be the autograph signature of the author.

It would take us too far to enter into the many interesting experiments undertaken by Gilbert in support of his arguments. But enough has been said to show that we have here a work well worth the attention of all interested not only in the early history of electricity but in any of its present applications.

Original Papers on Dynamo Machinery and Allied Subjects. By John Hopkinson, M. A. D. Sc., F. R. S. New York; *The W. J. Johnston Co., Ltd.*, 1892. 249 pages, 98 illustrations, 5x7 inches. Price $1.00.

The influence of Dr. Hopkinson's work on the construction of dynamo electric machinery has been of a character to warrant the assertion that it drew the designing of dynamo electric machinery from the slough of empiricism up to the firm ground of an exact science. A complete record of his work in this field, therefore, will be welcome to the student as well as to the practical designer.

In the volume before us we find the reprints of nine original papers by Dr. Hopkinson and read before various societies. The first two "On Electric Lighting," (1879) contain the original enunciation of the characteristic curve of the dynamo. But the most important, perhaps, is that on "Dynamo Electric Machinery," presented to the Royal Society in May, 1886. It was in this paper that Dr. Hopkinson first laid down the methods of the predetermination of dynamo electric machines, and in which the magnetic circuit in a dynamo received an analytical treatment similar to that which Ohm gave to the electric circuit. The best methods of the present day are based on this method first employed by Dr. Hopkinson; and hence the importance of thorough familiarity with the original source needs no further pointing out.

Among the other papers we find one on the "Theory of Alternating Currents," one on "Induction Coils or Transformers," and one also on the "Theory of the Alternating Current Dynamo."

To those interested in electric lighthouse illumination, the paper on "The Electric Light Houses of Macquaire and Tino" will prove exceedingly valuable.

Electric Lighting and Power Distribution, Part I. By W. Perren Maycock, M. I. E. E., New York; *McMillan & Co.*, 5x7 inches, 185 pages, paper. Price, 75 cents.

The raison d' être of this work according to the author is, that there was no reliable elementary work which he could recommend to the beginners in his classes at the City and Guilds of London Institute. In this dilemma the author was forced, as it were, to make his own text book, which we are glad to note is above the average of elementary treatises. Throughout, the author has treated the subject as if the student were before him, and in a language both clear and concise, while at the same time rigorously exact.

The present installment contains chapters on elementary conceptions of force, units, etc., after which follow others on current electricity, induction, electrical measurement and the principles of the dynamo. A valuable feature of the work are the questions which are appended to each chapter and which will enable the student to test his knowledge as he goes along.

The illustrations, with the exception of those representing standard apparatus, have been specially prepared for this work and will be found very helpful. We can heartily recommend this work to beginners.

New Dynamo Tenders' Hand-Book. By F. B. Badt. Electrician Publishing Company. Chicago, 1892. 226 pp. Pocket size. Price, $1.00.

This handy little work, though based on "The Dynamo Tenders' Hand Book" by the same author, is practically a new work, and has been elaborated considerably, without, we are glad to say, making it too bulky for ready reference. The author has entered a little more into the description of the general electrical data and theory of dynamos, which can do no harm to those for whom the book is intended. This is followed by a description of the methods of preparing a dynamo for operation, and a short discussion of the diseases of dynamos. The operation of arc and incandescent lamps, etc., is then taken up, and by a number of very good chapters, leads up to station equipment. Line construction, and the calculation of the size of wires, the application of storage-batteries, and the arrangement of power in the dynamo room, are also clearly set forth. A number of appendices give the rules of the various boards of underwriters, and of similar bodies. The little work is very well written, and the diagrams are quite numerous and help to elucidate the text.

Handbook of Electrical Testing. By H. R. Kempe. Fifth edition. New York, *Spon & Chamberlain*, 1892. 5½ x 8½ inches. 576 pp. Price, $7.25.

This work is too well known to require a detailed review at this time. It has indeed been the standard on the subject for many years, and it is all the more subject for congratulation that the author has in the present edition added largely to the original matter, while thoroughly revising it at the same time. To those engaged in electrical testing of whatever nature this work is simply indispensable. If we have a suggestion to make it would be that the author in the next edition embody the methods of determining mutual and self induction which now play so prominent a part in electrical and magnetic work.

AN ELECTRICAL EXHIBITION FOR ITALY IN 1895.

An international Exhibition of Fine Arts and Electricity is proposed to be held in Rome in 1895-96. It is intended to solemnize the 25th anniversary of the annexation of Rome to the Kingdom of Italy. The site chosen for the exhibition is in the vicinity of "Ponte Milveo," about a mile's distance from "Porto del Popolo," in a very attractive position, bordering on the river, and commanding a fine view of the Sabine Hills.

LEGAL NOTES.

INCANDESCENT LAMP LITIGATION IN BOSTON.

Following up its recent successful efforts against the Sawyer-Man, Westinghouse, Perkins and Mather Companies, as well as the proceedings that Mr. F. P. Fish is instituting against the Sunbeam Company in Chicago, the General Electric Company brought suit in Boston on Monday, Jan. 16, before the United States Circuit Court, Judge Colt sitting, against the Beacon Vacuum Pump and Electrical Company, for infringement of its Edison incandescent lamp patent, and asking for an injunction. The defendants were represented by Mr. Witter, who asked for a postponement of 30 days to enable the defendants to complete their work of making a new defence which, he claimed, would put a different complexion on the whole matter. He did not, however, disclose the nature of this new defence.

He was followed by Mr. Seward, for the complainants, who put in a strong plea for an immediate injunction, basing his argument upon the large amount of business these people were doing. Mr. Seward was followed by a Mr. Brandeis, of Boston, for the defence, and who made an argument for the Beacon Company emphasizing the main points in Mr. Witter's speech.

Mr. R. N. Dyer, of Dyer & Seely, New York, responded to Mr. Brandeis, on behalf of the prosecution, making a still stronger statement of the harm that would come to the General Electric Company from delay in granting the injunction because the defendants would be enabled meantime to run their factory at its highest capacity and fill orders.

Mr. Witter again took the floor, and answered several questions from Judge Colt, who showed himself willing to grant a delay provided the defendants were prepared to present a new defence in good faith. Mr. Witter then offered to retire with Judge Colt, and to put him privately in full possession of the entire defence, after which he thought the judge would certainly allow him the thirty days. Judge Colt said he would grant the defendants one week to get ready and to disclose their case publicly—namely, on Monday, Jan. 23.

Mr. Seward then tried very hard for a restraining order which would prevent the defendants from distributing or selling their product. This was refused. He then endeavored to secure an order of the court compelling the defence to supply the prosecution with information as to the nature of the new defence two days before next Monday. This was also refused, and the case therefore rests without further disclosure until the 23d, when, Judge Colt intimated, if the matter is worthy of further attention, ample time will be given to investigate and develop it.

Word reaches us from Chicago that on Saturday, Jan. 14, Mr. Fish secured, against the Sunbeam Company, from the United States Circuit Court, a restraining order which prohibits the sale of their incandescent lamps, but not the manufacture. It was not a regular injunction.

SOCIETY AND CLUB NOTES.

DISSOLUTION OF THE NEW YORK ELECTRIC CLUB.

As is well known, the New York Electric Club has been struggling with a heavy burden of debt and with a general apathy upon the part of its members, many of whom being members of other and larger social clubs have found it more to their interest and pleasure to frequent the places where the cares of the day would be forgotten rather than brought again to mind. In view of the steady tendency on the part of smaller clubs in New York to disintegrate, and of the difficulty in making ends meet, the officers of the club have determined after long and anxious deliberation that the only thing to be done is to dissolve the club. With this object, a petition has been made by a majority of the officers and by several of the largest creditors for the appointment of a receiver, to wind up the club's affairs; and the due legal steps are now being taken to carry out this programme.

RAILWAY ARRANGEMENTS FOR THE NATIONAL ELECTRIC LIGHT CONVENTION.

THE various passenger associations have granted an excursion rate of a fare and a third to delegates attending the Convention of the National Electric Light Association, to be held in St. Louis, February 28, March 1 and 2, 1893. To secure this rate it will be absolutely necessary for persons purchasing tickets to state to the agent from whom the purchase is made that they contemplate attending said meeting, and to procure from said agent a certificate which, immediately upon their arrival in St Louis, should be left in the Secretary's office, addressed to the undersigned, who will see that it is properly viséd and returned to the owner.

Arrangements are now being made for a special train from New York to St. Louis, which will exceed in the way of equipment and appointments anything that has ever been in service between these two points. To bring this matter to a successful issue, it is very important that the number of passengers who wish to avail themselves of this train should be known at the earliest possible moment. Therefore, it is very desirable, and will facilitate transportation matters greatly, if all delegates who contemplate using this train will make application for space at once.

C. O. BAKER, JR.,
Master of Transportation.
National Electric Light Association,
136 Liberty street, New York.

CANADIAN ELECTRICAL ASSOCIATION.

THE second convention will be held in Toronto on Wednesday and Thursday, January 25 and 26. The convention will assemble for its first session on Wednesday at 2.30 p. m. at the School of Practical Science, where the Association has been kindly invited to hold its meetings.

Among other matters of importance that will come before the convention will be the question of the division of the Association into sections representing special branches of industrial electricity. This separation is considered by many of the members to be necessary for the efficient working of the Association and the advancement of the different departments interested.

Many papers on subjects of special interest will be read, among which may be mentioned a paper by Prof. Rosebrugh of the School of Practical Science; papers on "Testing" by Mr. G. Black, of the G. N. W. Telegraph Co., Hamilton; "Free Wiring" by Mr. J. M. Campbell, of the Electric Light & Power Co., Kingston; "Underground Construction" by Mr. W. A. Tower, of the Bell Telephone Co., Toronto; "Steam Plant and Management of Electric Lighting Stations" by Mr. A. E. Edkins, of the Canadian Association of Stationary Engineers.

Besides an entertainment of a social nature, visits will be made by invitation to the stations of the local electric lighting companies and also to the new Exchange of the Bell Telephone Co.

The headquarters of the Association, during the convention, will be at No. 40 York street, at which address members are requested to call on arrival in the city.

PATENT NOTES.

EQUITY IN PATENT CASES.[1]

BY J. C. CLAYTON.

WHETHER or not the United States Courts, sitting in equity in patent cases, will venture to show a larger liberality in prescribing conditions for the granting of injunctions is a grave question. The statutory patent law rests upon the constitutional provision authorizing the granting of privileges to authors and inventors for the purpose of promoting the progress of science and the useful arts; and the Constitution itself was made to promote the general welfare of the people.

When, therefore, the law is so enforced as to maintain a monopoly that is destructive of the promotion of science or art, or that is against the general welfare, there is a violation of the constitutional and fundamental prerequisites. Though the patentee receives an exclusive grant, he remains subject to those constitutional qualifications; he cannot override them, nor can he overthrow the maxim, *Sic utere, non abutere.* No court of equity should sustain a patentee in the non use or the misuse of his invention. His patent is a contract between himself and the government representing the people, and is the result of a public policy primarily created for the welfare of the people.

Few inventors have ever long anticipated others in the same field; although. for his priority, the inventor gets a patent, yet, as a rule, in a few days or a few years, others would have reached the same result. It is, therefore, against natural justice that a right so given by the people should be used for extortion or oppression, or in any way against the general welfare. In a mere race of diligence Jones may secure a patent for a lamp over Smith, who may have been too late by one day. and Smith may have other cognate valuable inventions useless without the privilege of the Jones patent. Both may be great and successful manufacturers of lamps, and through their healthful competition the people may be greatly benefited. But, if Jones be upheld in his determination that Smith shall not on any terms use the Jones patent, then an "odious monopoly" is created, fair competition is destroyed, Smith is ruined and the people are completely at the mercy of Jones, the monopolist.

In such a case it would seem that a court of equity should be able to refues its peremptory injunction if Smith should secure a reasonable license fee to Jones. In other words, in the high court of conscience (the "court of equity") the familiar and highest principles of equity should govern; and the wrong of a harsh injunction should be balanced against the wrong of an infringement, while the court, holding a just balance between the actual parties, should remember that the public is, in no narrow sense, always an interested party in every suit upon a patent. I know that *strictissimi juris*, an exclusive right is granted to the patentee, and that in a suit, on the law side of the court, this legal right, no matter how harsh it may be, must be enforced. But if the patentee elect to enter the court of conscience rather than the court of law, he must abide by its more liberal and merciful conclusions.

Generally, "equity follows the law," but not to enforce the unconscionable or the cruel, nor to uphold unclean or unmerciful hands. Generally, too, when a patent is finally sustained on the merits, an injunction follows, which practically leaves the respondent and his business to be executed by the complainant without mercy or benefit of clergy! My view is, that there must be a new departure in this respect, either by judicial construction or by statute. And although I took no part in the incandescent lamp case, I was not without a hope that the court might find occasion to take the new departure above suggested.

Indeed, to a notable extent, it did depart from the harsher practice of the past, for it granted leave to apply for a dissolution of the injunction in case the complainant refused to supply its lamps to respondent's customers upon reasonable terms. To this extent I think the court made an advance in the line of mercy and liberality which has been herein suggested; perhaps in the next great patent case, where the respondent has his own additional patents and has invested millions in his plant, the court will go the length I have indicated and permit the respondent to continue his manufacture upon reasonable terms fixed by the court, with due regard to the interests of the parties and of the people.

Unless courts of equity more nearly approach such liberality, as they may by force of construction and constitutional law, some arbitrary statute inimical to patents will soon be enacted. Even now several harsh patent bills are pending in Congress. One authorizes the Secretary of the Interior and the Commissioner of Patents to fix the maximum price for the use of a patent, and provides that in case of a higher price being demanded the patent shall be forfeited to the public; another limits the term of a patent to seven years. In the wise and very liberal administration of equity all interested in patents will find their truest protection.

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[1] New York *Times*, Dec. 25.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JANUARY 2, 1893.

Accumulators:—

Secondary Battery, C. R. Arnold, Sharon, Hill, Pa., 489,115. Filed May 21, 1892.

A compound electrode consisting of a number of lead plates separated from one another by layers of lead shot.

Storage Battery Electrode, G W. Harris, New York, 489,186. Filed Apr. 14, 1892

Consists of two series of thin conducting sheets, each series united to an independent integral face, in combination with intermediate sheets of absorbent material.

Secondary Battery Electrode, A. M. Michel, Paris, France, 489,315. Filed Aug. 24, 1892.

Employs an amalgam in which the mercury at least equals in quantity the other metal.

Manufacture of Accumulator Plates, A. M. Michel, Paris, France, 489,316. Filed Aug. 24, 1892.

Consists of forming an alloy of lead and some other metal such as zinc, disintegrating the alloy, eliminating the metal alloyed with the lead, and leaving the latter in a porous condition, and finally compressing it into the desired forms.

Alarms and Signals:—

Fire Alarm, W. J. Schweiger, New York, 489,237. Filed July 11, 1892.

A concealed alarm adapted to be placed in the several rooms of a hotel, by which the guests may be alarmed from the office in case of fire and which will also display a card upon which are printed directions and means of escape.

Fire or Burglar Alarm, E. La France, Worcester, Mass, 489,312. Filed June 7, 1892.

Dynamos and Motors:—

Brush Holder for Dynamos and Electric Motors, R. Ashley, Philadelphia, Pa., 488,978. Filed Feb. 18, 1892.

Employs a spring actuated feed wheel to insure an equal pressure of the brush irrespective of the amount of material consumed.

Commutator for Dynamos and Electric Motors, H. Groswith and R. Ashley, Philadelphia, Pa., 489,000. Filed Feb. 18, 1892.

A disc commutator so arranged that any section may be readily removed without interfering with the others.

Transmitting Mechanism for Motors and Dynamos, H. W. Morton, Boston, 489,026 Filed Sept. 1, 1890.

Claim 1 follows:

The combination of a driving and a driven pulley, one of which is smaller than the other, with an idler provided with means for adjusting radially toward the smaller pulley so as to pinch the belt between the said idler and said pulley.

Alternating Current Dynamo, J. J. Wood, Ft. Wayne, Ind., 489,065. Filed July 22, 1892.

Employs a revolving multipolar field and a stationary ring armature; the field consisting of an axial core, an exciting coil around the core and alternated polar arms radiating from the opposite ends of the core, bending back around the coils and having their portions terminated in poles adjacent to the armature.

(See THE ELECTRICAL ENGINEER, Jan. 11, 1893.)

Armature for Electric Motors or Dynamos, C. F. Daniels, Macon, Ga., 489,070. Filed Dec. 2, 1891.

An armature composed of separate bobbins surrounding an axis to which they are secured by end plates and wedge-shaped clamping pieces.

Field Magnet for Electric Motors or Dynamos, C. F. Daniels, Macon, Ga., 489,071. Filed Dec. 2, 1892.

A field magnet consisting of two or more pieces of iron hollowed out to form cores bolted together.

Electric Motor, H. Illig, Bockenheim, Germany, 489,161. Filed Jan. 7 1892.

Comprises a solenoid in the main circuit, a current indicator connected with the core of the solenoid, a weight suspended from the core, an oscillating lever with a motor for actuating it, transmitting mechanism operated by the lever, and a registering device operated by said transmitting mechanism.

Commutator Brush Holder, C. F. Goodrich, Chicago, Ill., 489,185. Filed Dec. 29, 1891.

Employs means for controlling the pressure mechanism without detaching the holder from the machine.

Dynamo Electric Machine and Motor, W. T. Goolden and L. B. Atkinson, London, England, 489,302. Filed Aug 18, 1891.

Employs an air-tight non-magnetic casing surrounding the armature, having a jointed supplemental portion surrounding the commutator and brushes, and carrying the bearings.

Heating:—

Electromagnetically Heated Receptacle, W. Mitchell, Malden, Mass., 489,318, Filed Mar. 15, 1892.

Lamps and Appurtenances:—

Electric Arc Lamp, E. Thomson, Swampscott, Mass., 489, 046. Filed February 4, 1892.

Designed to operate on the stoppage of the feeding of the upper carbon due to its consumption or to its catching or holding up abnormally.

Electric Lantern, A. Keil, McKeesport, Pa., 489,150. Filed May 11, 1891.

Incandescent Lamp Socket, G. C. H. Foster, Bridgeport, Conn., 489,158. Filed Feb. 8, 1892.

Lamp Support, C. N. Wilcox, Brooklyn, N. Y., 489,172. Filed Jan. 28, 1892.

Measurement :—

Electrical Measuring Instrument, J. H. F. Görges, Berlin, Germany, 489,249. Filed Oct. 28, 1892.

A measuring instrument adapted for use with very heavy currents.

Metal Working :—

Electric Metal Working,, C. R. Arnold, Sharon Hill, Pa., 489,114. Filed May 17, 1892.

Claim 1 follows:

The herein described improvement in metal working by the electric arc consisting in setting up an extra or induced current in the circuit of the arc.

Miscellaneous:—

Elevator Indicator, N. Hiss, Baltimore, Md., 489,005. Filed Mar. 24, 1892.

Apparatus for Regulating Temperature, J. E. Watts, Lawrence, Mass., 489,052. Filed April 23, 1892.

Thermometric Indicator, C. R. H. Erkens, Lakewood, N. Y. 489,075. Filed Sept 15, 1892.

Operating Device for Bridge Gates, E. Zaremba, Chicago, Ill., 489,118. Filed March 5, 1892.

Temperature Indicator, J. Bartlett, Toledo, O., 489,212. Filed August 23, 1892.

Amalgamator, H. Calhoun, Hot Springs, & A. M. Beam, Bear, Arkansas, 489,216. Filed June 30, 1892.

Claim 1 follows:

In combination with an amalgamating vessel an electric generator connected therewith and adapted to deliver an interrupted current of constant direction.

Telegraphs :—

Telegraphy, Z. P. Hotchkiss, Oak Park, Ill., 489,435. Filed Apr. 18, 1891.

Employs a recording ribbon perforated by a stylus, actuated by an electromagnet, and a second stylus following in the line of the first, by means of which the perforations made by the first are enlarged.

Telephones and Apparatus :—

Telephone Switch, J. C. Francis, New York, 488,993. Filed Feb. 15, 1892.

Consists of a rotatable hook for supporting the telephone receiver, having a shaft rotating with it and bearing a commutator in contact with brushes for automatically cutting out the signal device when the receiver is removed from the hook.

Testing Apparatus for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 489,098. Filed June 19, 1888.

A "busy" test for telephone central stations.

Testing Apparatus for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 489,099. Filed June 19, 1888.

Similar to 489,098.

Test-Circuit for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 489,100. Filed Mar. 1, 1890.

Similar to 489,098.

Telephone Switch Appliance, P. Rabbidge, Sydney, New South Wales, 489,266. Filed Jan. 2, 1892.

Employs a reversible vessel, insulated end plugs, a set of contacts extending through the plugs into the vessel, and mercury within the vessel.

Electromagnet, R. Varley, Jr. Englewood, N. J. 489,277. Filed June 13, 1892.

Employs a double winding for the magnets; one wire being bare and its successive convolutions separated one from the other by those of the second wire, which is insulated. See page 75.

Combination Fuse Box, W. F. Bossert, Utica, N. Y. 489,364. Filed Dec. 14, 1892.

Claim 2 follows:

The combination of the movable conductor, a movable supporter therefor, a catch for securing the supporter, and a fuse wire holding the catch.

Valve Controlling Clutch, J. P. Tirrell, Boston, Mass., 489,424. Filed Mar. 7, 1891.

Has for its object to enable the armature of an electromagnet to act as a coupling device to engage an electric clutch with the pulley, and thus cause one of the parts to give motion to the other.

Case for Electrical Measuring Instruments, E. Weston, Newark, N. J. Design 22,101. Filed Dec. 7. 1892.

Railways and Appliances :—

Trolley Wire Support, G. H. Scranton & L. Spillman, Columbus, O.. 489,097. Filed May 27, 1892.

Consists of a plate having a rounded lower side and a grooved upper side, in which the trolley wire lies, and a bracket arm overhanging the plate for the purpose of suspension.

Fender for Electric or other Cars, M. S. Starkweather, Boston, Mass., 489,207. Filed July 18, 1892.

Electric Railway Trolley, J. Reutlinger, St. Louis, Mo. 489,234. Filed July 30, 1892.

Claim 1 follows:

A trolley having teeth arranged on the side and insulated from the body portion.

Electric Elevated Railway, A. L. Rutter, Washington, D. C., 489,330. Filed Feb. 20, 1892.

An electric railway employing cylindrical cars suspended from an overhead track.

Underground Conduit for Electric Railways, C. P. Tatro, Spokane, Wash., 489,422. Filed Mar. 23, 1891.

Relates particularly to means of communication between the rail and the line wire, and also means for mounting the trolley carriage upon wheels in the conduit, and connecting it with the car by a flexible conductor.

NEVER FAILS TO RECOMMEND IT.

A Southern electrical railway builder and engineer writes us in renewing his subscription:—"You well know my high appreciation of your valuable paper; and I never fail to recommend it to those looking for an electrical journal."

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

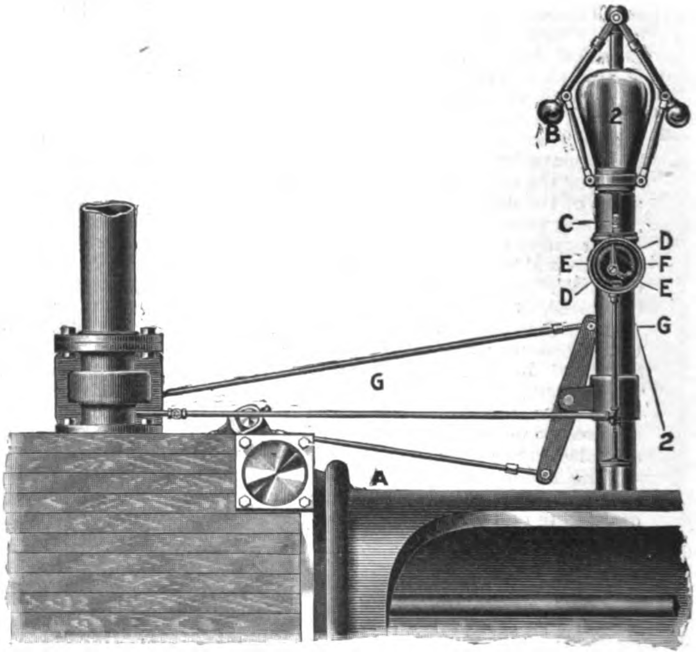
THE BARCLAY AUTOMATIC GOVERNOR STOP.

The accompanying illustration shows James Barclay & Co.'s automatic safety governor stop for the Corliss engines, manufactured by the Sioux City Engine Works, of Sioux City, Iowa.

The engine is provided with the usual governor connected with the valve mechanism of the Corliss type of engine, or with the valve stem of throttling governors. The governor is provided with its usual sleeve C adapted to rest on a stop made in the shape of a lever when the steam is shut off by the engineer. When, however, an accident happens to the governor, while the engine is running, the stop D being moved from under the sleeve permits the governor to drop sufficiently to completely shut off the steam from the engine.

The lever is fulcrumed within a casing attached to the support of the governor, and provided with an extension pivotally connected by a link with the closed end of a spring tube F, bent in the shape of a segment of a circle, and connected at its open end with a pipe G leading to the supply pipe or other part of the steam chest.

It will be seen that when the steam passes through the pipe G into the tube F the latter swings outward at its free end, thus exerting with this free end a pull in the extension of the lever whereby the latter swings from under the sleeve C to permit the latter to drop below its normal position in case of accident to the governor. As soon as the steam is cut off from the pipe G by closing the valve in the inlet pipe to the cylinder, then the tube F is relieved of the pressure and consequently its free end contracts so as to move the lever back to its normal vertical position, to support the sleeve C in a normal position.



Barclay Automatic Governor Stop.

THE BISHOP GUTTA-PERCHA COMPANY.

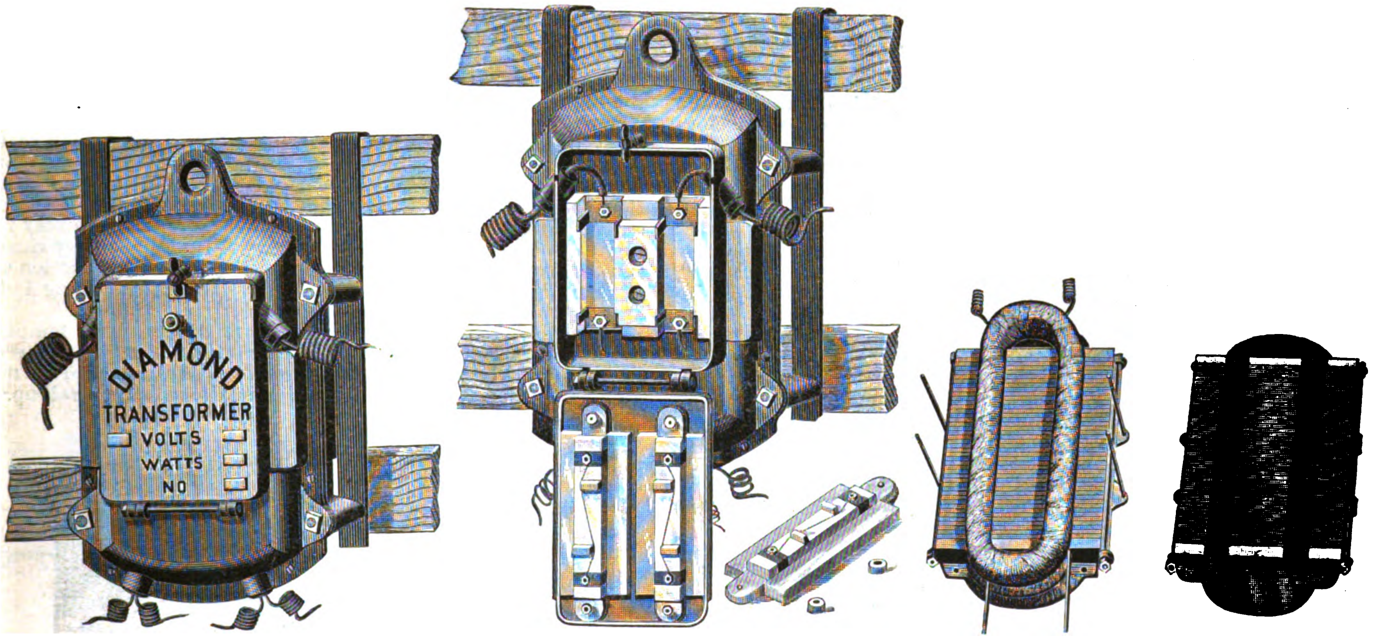
The Bishop Gutta-Percha Company, at a meeting of stockholders, held Jan. 11, reelected the old board of directors, Sam. Boardman, Helen E. Blitz and A. Spadme, and the board elected Sam. Boardman, president, Helen E. Blitz, vice-president, and Henry A. Reed, treasurer and secretary. Mr. Samuel Boardman, senior member of the firm of Boardman & Boardman, attorneys, 155 and 157 Broadway, has been concerned with the Bishop Company for more than 30 years, first as attorney for Mr. Bishop, then as attorney in fact, and agent for Mrs. Bishop and later as her executor. On closing her estate, in 1885, he organized the present company, and has since held the offices of president and treasurer. Henry A. Reed was employed by Mr. Boardman under his Executorship as an expert to prepare evidence in defence of a threatened suit for infringment of the Simpson patent and as accountant in settling the estate. On the organization of the company, Mr. Reed was made its secretary, and one year later its general manager. On account of the ill health of Mr. Boardman Mr. Reed has for several years been acting treasurer so that in receiving the title his duties are not changed.

THE "DIAMOND" TRANSFORMER.

It is only within a comparatively short time that transformers have been manufactured apart from generating apparatus. Practical experience, however, had suggested so many economies that might be effected by improved types of transformers, that about two years ago factories outside of parent companies were established for the exclusive manufacture of transformers and kindred articles.

The diamond transformer is the latest type of these independent efforts, and embodies, it is said, all that experience has obtained from the good qualities of other converters, while it is claimed to obviate all of their defects.

A transformer to be popular in these days with the superintendent of central stations and with linemen, must be convenient and unattended with any abnormal difficulties in placing upon poles or buildings. Our engraving, Fig. 1, illustrates the transformer as it appears when attached to the cross arm. It will be seen that this converter is easily adjusted and held in secure position by the hooks engaging with the cross arms. The ring in the top is for hoisting it upon a pole by means of a block and tackle. Should it be necessary, however, to attach the converter to a brick wall, the hooks may be easily removed and the converter secured to the wall by means of the four lugs seen in the cut. The diamond transformer is also made "three-point" and is easily and quickly convertible from 50 to 100 volts on the secondary wires without the use of a more or less clumsy and inconvenient switch.



Figs. 1, 2, 3 and 4.—The Diamond Transformer.

Fig. 2 shows the transformer with fuse box exposed to view. The primary and secondary connections are readily seen, and it will also be noticed that when the door is closed each fuse is in a separate compartment, so that in case one should blow out, it would have no effect upon the other by excessive heating. The porcelain box and fuse blocks are highly glazed, and it is claimed that there is no danger of their absorbing moisture. The convenience of this style of fuse box will thus be apparent. The fuse blocks are attached to the door itself; it follows that when the door is opened the connection is completely broken, and a lineman may replace fuses upon a live wire with perfect safety, at the same time having the fuse blocks entirely exposed to view. The fuse blocks themselves may be detached by means of a little knurled thumb-piece, seen by the side of the detached block. These fuse blocks are interchangeable for all sizes of transformers, so that a central station, by keeping a few of them on hand, may always be assured of a fuse block in case one upon the line should be destroyed by lightning or otherwise.

It has been a source of inconvenience and expense to central stations heretofore to return burned-out converters to their respective factories to be repaired or replaced. The delay has often caused serious inconvenience, and it has resulted in many cases in the largers tations making ineffectual attemps to repair the converters themselves. Figs. 3 and 4 illustrates one of the most important features of the diamond converter, which will be appreciated by practical central station men. It will be seen that the secondary coils are in two parts, the primary coil being securely embedded between the two, thus affording a common centre of magnetism. After the primary coil is in position the secondary coils are adjusted and firmly bolted together, completing a perfect magnetic circuit. Should, however, a primary coil be burned out by lightning or otherwise, it is only necessary to have another coil sent by express when the central station man can readily place it in position himself, thus obviating all the delay and expense which was a necessary part of the old methods.

The Diamond converter is of very high efficiency, low leakage current and excellent regulation. It is made as light in weight as is consistent with the best practice, and is well ventilated through the top and bottom of the case, so that a free passage of air will aid in keeping the coils at a low temperature.

Messrs. Taylor, Goodhue & Ames, 827 Monadnock Block, Chicago, Ill., have taken out the exclusive agency for the sale of this converter, and have in course of preparation a pamphlet treating quite extensively of its merits.

AN INTERESTING PLANT IN THE HICKOCK WORKS, HARRISBURGH, PA.

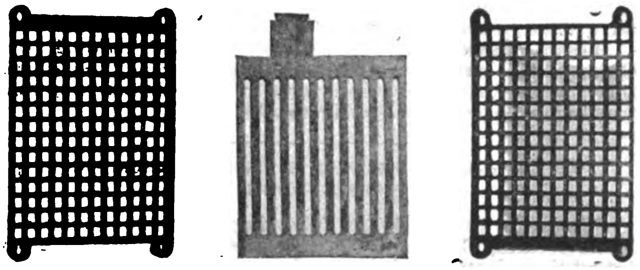
We are in receipt of the following from the W. O. Hickok Manufacturing Company, of Harrisburgh, Pa., who have a very interesting electric lighting and power plant in their factory, where bookbinders' machinery is made. The factory covers considerable ground in the form of a quadrangle, and was built in 1890, since which time the plant has been gradually increased:

"Our establishment is run by electricity. We have a machine department, which covers a floor space of about 250 x 80. The machinery in this department is arranged the full length of the floor in four rows; two rows of machines back to back on each side of a broad central aisle; two main lines of shafting run the full length of this department, one line over each double row of machines. About in the centre of each of these lines of shafting we have a small house built against the side wall, having glass in front and on either side, one side being occupied by a glass door. A slanting roof, tinned on the top, covers this motor house. Thus we protect the motors from injury by water in case of fire and keep them free from dust. In each of these motor houses we have a 20 h. p. 'C. & C.' motor, and we belt direct from each of these motors to their respective line shafts, thus dividing the power in our machine department in a most convenient form. We also conduct two floors in our wood-working department, and on each of these floors have a motor of the same make and size, housed in the same manner, one of these motors also giving power to a 10 x 15 foot platform, five-ton 'Graves' elevator. We are preparing to run our cupola fan and foundry rattler by independent motor. Our testing department supports several small motors. We have found that the 'C. & C.' motor has been so economical in the line of repairs, and has given so much universal satisfaction, that we are confining ourselves to that make.

"Our foundry, machine shop, smith shop, wood-working department, yard and office are all illuminated with electricity, We believe the division of power and arrangement of our plant gives the best and most economical result that we have had the pleasure of inspecting in the line of electric power for manufacturing purposes."

THE ACME STORAGE BATTERY CAR.

The Acme Storage Battery Company have equipped a car of the Ninth avenue street car line with a set of their batteries and have been conducting a series of tests on the road between 53d and 125th streets. A public test was made on Jan. 11, the car containing a number of representatives of the electrical and daily press, and doing its work very creditably, notwithstanding the very slippery condition of the tracks.



Acme Storage Battery Plates.

The equipment consisted of 144 cells, arranged in 12 boxes, six on either side of the car, the whole weighing 8,500 pounds. The car had a Baker truck and a McDougall motor capable of developing 30 h. p.

The Acme cell weighs 27 pounds against 40 pounds for a cell of the same dimensions using lead grids. The grids are of a non-conducting material which is not attacked by the acid and which is sufficiently elastic to yield to the expansion of the active material without buckling, warping or breaking. On the other hand, the active material is retained with sufficient firmness in contact with the conducting plate of lead which is situated in the middle of the complete plate. There is an equal amount of active material on each side of this lead conducting plate, thus ensuring an equal distribution of current. The form of the grids is shown in the accompanying illustrations.

Ribs on the non-conducting grids meet through slots in the conducting plate, and are cemented together, uniting the whole into one solid plate. The openings for the reception of active material are smaller on the outside to aid in the retention of their contents. The exposed surface of active material is about 40 square inches on each plate or about 200 square inches for the five positives.

During the test a grade of six per cent. half a mile long was climbed. The maximum steady discharge on this hill was 130 amperes or about .65 ampere per square inch.

THE JOSEPH DIXON CRUCIBLE CO.

The Joseph Dixon Crucible Company, of Jersey City, are taking time by the forelock by putting up a fifth story, 175 x 75 feet, on their pencil factory. The new addition will be equipped with new and improved pencil machinery of their own invention. The Company will also establish a rubber and brass plant for the manufacture of the various pencil accessories and novelties. As it was only in 1891 when the Dixon Company put extensive additions on their crucible and black-lead works, and erected offices which for size and beauty are second to none in the State, it seems evident that prosperity claims the Dixon Company for its own.

E. W. BLISS CO.

This company, of 17 Adams street, Brooklyn, N. Y., report that the past twelve months have witnessed by far the greatest enlargement and most extensive improvements in their works that have taken place during the history of the concern. After amalgamating with their business that of the Stiles & Parker Press Co. it was decided to move the entire plant of the latter company to the Brooklyn works. Partly to accommodate the increase of business in that direction, an additional building was erected 150 feet long by 90 feet wide and six stories high. The machine shops now occupy the entire block bounded by Adams, Pearl, John and Plymouth streets, and enclose in the centre an erecting shop for heavy machinery, spanned by a 25-ton electric traveling crane. A large number of new machine tools have been put in, and some large, special boring and milling machines are being built.

The company have also equipped a portion of the works with special machinery for the manufacture of Whitehead torpedoes and torpedo guns, which they are making on contract with the United States Navy Department. The development of this branch of business has called for much mechanical skill and elaborate investigation, not to speak of the large investment. All departments have been well filled with orders during the year, the prospects are thoroughly good, and they expect to make still further extensions of their already large facilities.

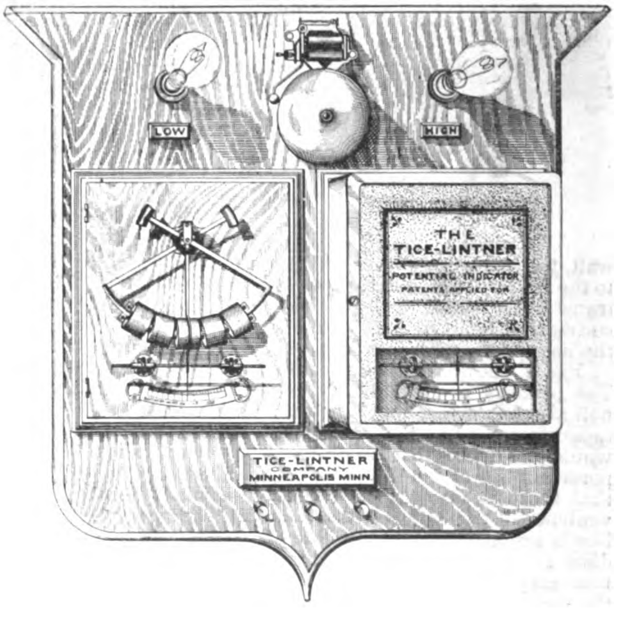
THE TICE-LINTNER POTENTIAL INDICATOR.

Recognizing the necessity of close potential regulation, and believing that with more perfect regulation, lamp breakage would be reduced to a minimum, the Tice-Lintner Electric Company, of Minneapolis, have brought out an instrument which combines with a voltmeter of the highest degree of accuracy, permanency and dead-beat qualities, an alarm attachment of equal reliability which immediately attracts the attention of the attendant to any change or variation in pressure. Red and green lamps to indicate whether the pressure is high or low, are provided and lighted simultaneously with the ringing of the alarm bell.

The accompanying engraving shows a general view of the instrument adopted for the three-wire system. The instrument is wound in such a manner as to produce a field of the greatest intensity, with the lowest possible temperature co-efficient and contains nothing in its make-up subject to change or deterioration. The intensity of field results in the indicator being little affected by the close proximity of circuits carrying heavy currents or by other similar disturbing agencies so troublesome to most measuring instruments. In its construction it has been the aim of the inventors to concentrate the action within the normal limit of the system on which it is placed, so as to give to the index arm the requisite degree of force essential to a circuit-closing device.

Two delicately-balanced armatures of the softest obtainable iron, to one of which is attached the index, are acted upon by the magnetic field of a curved solenoid in such a manner as to form opposite poles at their contiguous extremities, the mutual attraction of which greatly augments the directive force of the solenoid. This attractive force of the iron cores increases very rapidly as they approach and diminishes as rapidly as they recede, thus giving to the instrument the greatest delicacy of action and securing wide range of movement to the circuit-closing index arm for the slightest change of potential.

The alarm circuit, together with that of the signal lamps, is completed through one of the platinum-tipped contact points set on either side of the index, and which are adjustable, by turning a milled head, to any desired range, from a fraction of a volt up. If desired, the contact points may be removed to the extreme ends of the scale to permit of using the instrument as a voltmeter.



The Tice-Lintner Potential Indicator

The indicator is now in successful operation in some of the largest lighting plants in the country, and its introduction has been attended with a marked diminution in lamp breakage, as there can be no perceptible increase of potential without the dynamo attendant being immediately apprised of the fact and the same remedied before any damage ensues.

THE VARLEY DUPLEX ELECTROMAGNET.

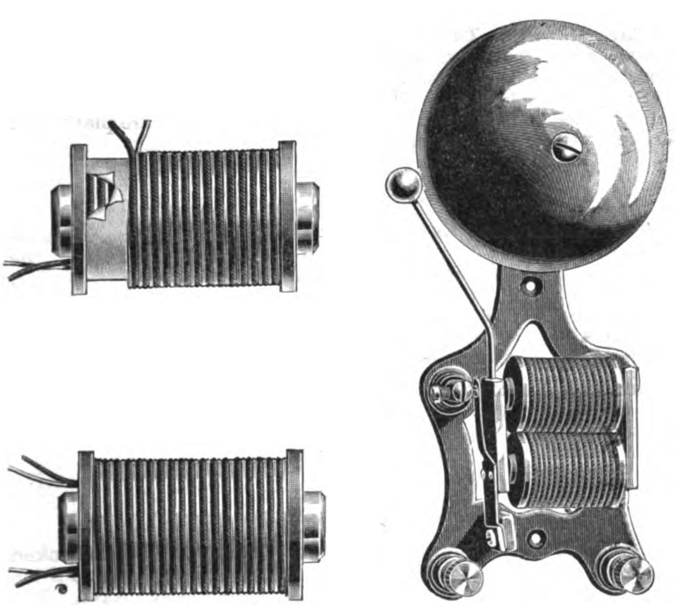
BY

McSullivan.

At a time when the electrical community is practically at a standstill so far as the invention of novelties is concerned, it is pleasant to know that the inventors are not idle and that the patent office continues to turn out its usual quota of patents relating to electricity in its varied applications.

Most of the patents of late however have been of a specific character and either relate to improvements in the quality of the article or cheapness in its method of manufacture. Among the latter is one relating to a new method of winding electromagnets and called by its inventor, Richard Varley, Jr., the duplex method.

This method of winding magnets is a novel one and is a wide departure from the methods heretofore in vogue. Fig. 1 shows a magnet in section, with a portion of the interior exposed. It will be seen that a bare and an insulated wire are wound simultaneously, the insulation of the covered wire serving the purpose of keeping the turns separated, and paper being used between each layer. This method necessitates the use of a machine which has been designed for the purpose. The magnet when completed has four ends, and these, in the case of a simple magnet, are connected in series, or in multiple in the case of galvanometer coils, etc., where a differential circuit is required. This is easily accomplished, the very nature of the method of winding making it possible to have any combination of circuits, series, parallel or differential. Fig. 2 shows a magnet complete and Fig. 3 an ordinary bell with duplex magnets. Owing to the fact that insulated-magnet wire in the smaller sizes costs about twice as much as bare wire of the same size, it will be seen that with one-half the wire on every magnet by the duplex method being bare, a considerable saving in the cost of wire is effected, even if the number of feet of wire were the same as if all insulated wire were used; but, as this method makes the magnet more compact, the required number of turns are secured in a smaller space, and a saving is effected in the amount of copper used when considered by weight, or in price when considered from the standpoint of insulation.



Figs. 1, 2 and 3.—Varley Duplex Electromagnet.

When one stops to consider, it seems unfortunate that as the many convolutions on a magnet where the current is slight, as in the majority of smaller magnets, have only to be separated an infinitely short distance from each other, this distance is of necessity made much greater than is actually needed, because of mechanical reasons.

Magnet wire is usually covered with some fibrous insulating material in the form of yarn, and this in order to stand the strain of the winding machinery must be of sufficient tensile strength. This consideration, of course, being a necessary one, we find that a wire when insulated has a very much increased diameter, and the insulation is much thicker than would be put on for this service if no other than electrical considerations were to prevail. As the diameter of the wire is increased it requires a greater amount of wire to get the necessary number of turns to give a magnet the required strength, and the complete magnet is much larger than if it were possible to use a wire of a smaller diameter. These conditions are practically the natural result of winding magnets as it is done at the present time. The manufactured magnets, when all insulated wire is used, are quite at variance with the principles which govern the operation of this device when looked at from a scientific standpoint, that of an ideal electromagnet.

An electromagnet approaches its ideal efficiency when all the limiting space around the iron core is occupied by energizing current, without any intervening air-space. This, of course, can only be accomplished when the limiting space is occupied by but one turn, in which case no losses are due to insulation. When a departure is made from this theory the losses increase as the number of turns which have to be put on to get the required saturation. In other words the nearer we approach the utilization of the available space around the core, as completely as possible, with nothing but a conductor, the nearer we approach the ideal magnet from a standpoint of economy as well as efficiency. This condition would render the length of wire as small as possible, because the diameter of the successive layers being decreased, it takes less wire to secure the required number of windings. Conditions, of course, known as ideal are as a rule impossible to obtain in practice, yet, at the same time, it will be seen that Mr. Varley's process is a great step in advance of the present usages in this department of electrical manufacture. It is a step that affects this branch of manufacture more than would appear at first sight, because, as before stated, the cost of manufacture is materially reduced. The valuable space that is gained by dispensing with one-half of the insulation renders it possible to make the magnet more compact, thus making a great step forward toward what may be considered the ideal magnet. In the case of such apparatus as fire alarms, railway-signals, and the telephone service where the element of space is an important consideration, the duplex method, which makes a magnet smaller without decreasing its strength will be of great value in these fields alone, if from no other consideration. The machine for making these magnets was designed by Mr. Varley, and, being automatic to a great extent in its action, uniformity in the magnets made on it is but a natural result.

The Varley Duplex Magnet Company has been organized for the purpose of introducing this invention, with offices at No. 136 Liberty street, New York City.

A NEW FACTORY FOR THE GIANT ELECTRIC MOTOR COMPANY.

A Portland, Me., newspaper says: "The second grand boom for our village cousin on the other side, and one that will add nothing to the very active appearance of Portland, will be the removal of the Giant Electric Motor plant from Commercial street to one section of the Mussey farm at the Cape Elizabeth. Plans have been laid for the erection of four large two-story buildings in the direction from the plush mill toward the ferry slip. The buildings will be of iron with brick interior, and will be built by the Berlin Iron Bridge Works, of Berlin Falls, Connecticut. The dimensions of each building will be 150 by 75 feet, and will cost $25,000 each. The architect is Elmer J. Thomas, of Auburn. The work on the first building will be started as soon as the ground is in a fair condition for breaking which will probably delay the matter of laying the foundation until spring. It is further proposed, according to the plans that have been drawn, to later adjoin the second building of 150 by 75 feet to the first building of the same dimensions. A short distance away a third building of the same dimensions as the two others will be erected, and eventually a fourth building adjoined to that, making two immense double iron edifices. Several sets of machinery run by as many motors, will be put in operation instead of one long shafting with a single motor supplying the power. It is thought by this that considerable power that is lost by the use of long shafting will be saved, and in case of a break down of any single motor the machinery will continue and work would not be suspended. An electric crane something like the one now in use at the Portland Company, and which will cost the big sum of $10,000 is to be one of the features of the plant. Six months ago there were seven men employed in the Giant Electric Motor Company, and but a small plant. To-day there are 50 skilled workmen employed while the machinery has been increased until it is now seven times larger and valued in proportion. While some of the credit is due to the men at the head of it, considerable praise must be credited to Superintendent Upp who has succeeded in bringing the work to so high a standard. Among the contracts now on hand is one to supply 10,000 arc and incandescent lights in the White Mountain region this coming spring at a cost of $60,000."

LECLANCHÉ BATTERIES.

Mr. R. Aylmer, of 47 Victoria street, London, England, has been appointed sole concessionaire for the manufacture and sale of Leclanché batteries in Great Britain and the Colonies, and has issued an interesting catalogue descriptive of various styles of these well known cells.

MESSRS. WATERHOUSE, GAMBLE & CO.

The Waterhouse arc lamp, which, it will be remembered, was described and illustrated in our columns some months since, has passed beyond the experimental stage and seems to have warranted all the confidence reposed in it. Messrs. Waterhouse, Gamble & Co., of 45 Broadway, this city, are now manufacturing these lamps on a commercial scale and have received many testimonials from users in regard to their satisfactory working. They are now prepared to furnish a single carbon lamp for ⅝-inch carbon to burn 15 hours, as well as lamps adapted to burn on circuits of variable E. M. F., by means of an automatic regulating device. They also make various forms of resistance hangers for lamps under different conditions.

MARQUAND, SKEHAN & CO.

The banking and brokerage firm of Marquand, Skehan & Co., of 16 Broad street, which has already made a distinct place for itself in the *haute finance* of Wall street, has begun the New Year under brighter auspices than ever. It has now admitted to partnership Mr. Abram C. Bernheim, late of the firm of Bernheim, Bauer & Co. The style of the firm will remain unchanged, but as the new member is connected with the influential management of the Manhattan Electric Light Company, the firm will be in an even more advantageous position for enjoying a practical control of dealings in local electric light stocks.

500-VOLT MOTOR CIRCUITS.

With regard to the recent discussion in our columns of the growing use of 500-volt motors, the Motor Department of the General Electric Company writes us:

> For two years past we have been putting in 500-volt circuits for power purposes and have them now fairly well distributed throughout the country. Nearly every town of any size has a 500 or 220-volt circuit. Boston has both 220 and 500-volt circuits, but the demand in this city is largely for 220-volt machines, although the company controlling the 500-volt circuit is now pushing out for power work. In Providence a 500 volt circuit has been operating for two years, and we now have between 500 and 600 h. p. in motors on it.

A COMMERCIAL CABLE SOUVENIR.

The Commercial Cable Company has issued to its friends a very handsome souvenir in keeping with the recent holiday season. It is in the form of a card with the customary holiday greeting, and contains a well-executed picture of the company's offices at Wall and Broad streets as they appeared during the Columbus Quadri-Centennial Celebration. The tasteful decorations of the structure, which won so much merited praise during the celebration, are well brought out in the card.

WIRE AND WIRE ROD MILLS' COMBINATION.

A special dispatch from Pittsburgh, of Jan. 8, says that a deal is being engineered to consolidate the wire, wire nail and wire rod interests in the United States. If the combination can be effected it will be one of the biggest concerns in the country. The capitalization will be $25,000,000.

The proposition comes from the Washburn-Moen Company, and was made to the Consolidated Company, with headquarters in Pittsburgh and Chicago. A barbed-wire trust was organized about three months ago, but the idea is to wipe out the limited consolidations and unite all in a grand combination that will regulate the output and maintain prices.

WESTERN NOTES.

The Central Electric Co., 118 Franklin street, find that the demand for Interior Conduit and Lundell motors is considerably on the increase. They have devoted a department exclusively to the manufactures of the Interior Conduit & Insulation Co., New York. Mr. H. H. Small, for some years manager of the Western supply department of the Thomson-Houston Electric Co. will assume the charge of this new department.

Mr. Harry Bishop, formerly New England agent of the *Street Railway Gazette*, has accepted the position of Western sales agent for the Massachusetts Chemical Co., with offices at 823 The Monadnock Building. Mr. Bishop comes well recommended, and will doubtless build up a fine business for the "Insullac" people in the West.

L. H. Hart, formerly business manager of the W. J. Johnston Co., spent several days in Chicago recently in the interests of the new journal, *Heating and Ventilation*, of which he is business manager. He renewed some old acquaintances in the Rookery, and of course called on the Engineer. All wish him success in his new venture.

Mr. H. M. Swetland, president of the *Power* Publishing Co., was a welcome caller at the office this week.

The Chas. E. Gregory Company, capital $50,000, has been formed with Chas. E. Gregory as manager, to deal in complete steam and electrical equipments. The wonderful growth of Mr. Gregory's business during the last year has necessitated this move so that he may be able to handle the immense business now enjoyed.

Mr. H. M. Linnell, managing director of the Automatic Telephone & Electric Company, of Canada, with office in the City of Montreal, has been in this city for some days. There is considerable stir in Strowger telephone matters in Canada, and several important exchanges are well under way.

Mr. W. Taylor, of Taylor, Goodhue & Ames, has an interesting New Year's article on electrical development, in the Chicago *News-Record.*

PHILADELPHIA NOTES.

"Queen & Company, Incorporated."—Among recent business changes of special interest to the electrical fraternity is the transferring of the business of James W. Queen & Co., Philadelphia, to a stock corporation bearing the title Queen & Co., Incorporated. The new company starts with a paid capital of $600,000, which will be increased from time to time as may be required for the extension of its numerous interests, which in addition to electrical measuring instruments now comprise scientific apparatus of every description. The incorporators and Directors for 1893 are S. L. Fox, E. B. Fox, J. G. Gray, W. Biddle, Jr., J. G. Biddle, and F. W. Stanwood, all of whom have been actively connected with the old fim. E. G. Willyoung continues as superintendent of the electrical laboratory.

The Scranton Traction Co., of Scranton, Pa., have placed the contract for the buildings of their new plant with The Berlin Iron Bridge Co., of East Berlin, Conn. The boiler and engine room will be 65 feet wide by 200 feet long, with a machine shop and car shed 93 feet wide by 225 feet long. The entire plant will be fire-proof, of the well-known Berlin construction.

NEW ENGLAND NOTES

The Berlin Iron Bridge Co., of East Berlin, Conn., have secured the contract for a new iron fire-proof store house for the Pope Mfg. Co., at Hartford, Conn. The building will be 40 feet wide by 84 feet in length, two stories high, and will be used for storing the separate parts of bicycles, as the Pope Company have to carry a very large stock of the different parts to supply the wants of the numerous users of the Columbia safety.

The New York Insulated Wire Co., has opened a branch office at 182 Summer Street, Boston, where it will carry a full stock of all its specialties for the New England trade. Mr. Walter S. Barker will be the selling agent.

NEW YORK NOTES.

The E. P. Gleason Manufacturing Company have just broken ground for the erection of a four-story building to be an addition or extension to their already large glass works in Brooklyn. The new buildings will be used principally for finishing glassware for illumination, *i. e.*, polishing, cutting and etching the articles after they have gone through the glass house proper. The company have erected two buildings last summer to increase the output of their glass factory, and this building is now necessary, as their finishing shop, which at present consists of a three story building, 100 feet front x 150 feet deep, is too small for the increasing trade of the company.

CANADIAN NOTES.

The Packard Lamp Co., Ltd., of Montreal, notwithstanding the fact that they recently more than doubled the capacity of their factory, are contemplating its further enlargement in order to be able to meet the demand for their lamps, for which orders are coming in faster than they can be filled. The factory of this company, Nos. 96 to 100 King street., Montreal, is equipped with the most improved machinery for the manufacture of incandescent lamps of any candle power and voltage, to fit any base. The lamps manufactured there are the latest improved "Packard High Grade" incandescent lamps, similar in all respects to those made by the New York and Ohio Co., at Warren, Ohio, and are meeting with the greatest success among the Canadian trade, as is shown by the continually increasing demand for them throughout the Dominion.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XV. JANUARY 25, 1893. No. 247.

THE CARBON FILAMENT LAMP OF 1859.—THE STORY OF AN OVERLOOKED INVENTION.

BY

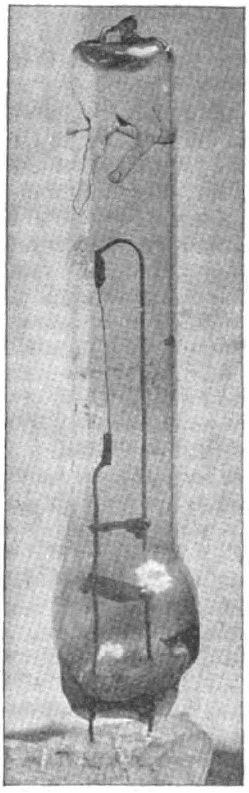
Franklin Leonard Pope

Incandescent Lighting, Union Square, 1859.

THERE will probably be more than one reader of this article, whose memory of street-scenes and incidents in the city of New York runs back thirty years or more, to a period "just before the war," who will recall, among the various well-known street spectacles of that day, a peripatetic astronomical observatory, which might frequently have been seen in the full tide of successful operation on pleasant evenings, in one of the open spaces of the up-town streets, perhaps more often than elsewhere in Union Square, or in the vicinity of the Cooper Institute. This establishment consisted of a four wheeled wagon, between the shafts of which stood a pony usually contentedly munching a wisp or two of hay; and a refracting telescope, fifteen or twenty feet in length, mounted upon the wagon, with its eye-piece in convenient proximity to the ground and its opposite extremity directed towards the constellations of the firmament. The exhibitor, a kindly-faced, middle-aged German, with the manner of a gentleman as well as of a student and a philosopher, could usually be heard enthusiastically discoursing, in picturesque English with a strong Teutonic flavor, to an assemblage of all sorts and conditions of men, women and children, upon the wonders of the starry heavens, and upon the remarkable phenomena which might be seen by those who were sufficiently curious to pay a small fee for the privilege of gazing through the telescope at the various celestial objects within its range. The philosopher was usually accompanied by a small boy, whose duties consisted principally in looking after the pony, and in officiating as assistant cashier, when business was brisk. Whenever the interest of the auditors began to flag, or they evinced too great a tendency to straggle away, their attention was not infrequently aroused anew by the sudden flashing out from the obscurity behind the driver's seat, of two or three brilliant lights of mysterious origin and appearance, which were explained to be caused by the action of electric batteries concealed in a couple of large chests at the front and rear of the wagon. The exhibitor was accustomed to speak of these pieces of apparatus to his motley audience with pardonable pride, for not only the telescope, even to the shaping and grinding of the lenses, but the mysterious electric lamps, and the batteries by which they were brought into action, were the work of his own hands.

Then followed the fateful years of the war of the rebellion, and in the frenzied excitement of rapidly recurring events at the front, the milder diversion of star-gazing lost its power to charm. The telescope wagon with its owner disappeared, and the places that had known them knew them no more. But now, after the lapse of a generation, the almost forgotten astronomer of the boulevards suddenly finds himself the centre of attraction in the world of electricity, for in some of the still existing electric lamps of that former time, modern science recognizes, not only the general principle, but most of the details of construction as well, which go to make up the incandescent electric lamp of to-day.

It is a trite saying that "truth is stranger than fiction," and surely nothing could be more strange and more dramatic even, than the unexpected discovery, almost at the very moment of the final decision which marks the termination of years of protracted and costly litigation, of a pre-existant lamp embodying the very principles, nay the very forms, of the invention so long in controversy, accompanied with what must be admitted to be almost irrefutable evidence that it had been made and publicly exhibited to hundreds if not thousands of people in the streets of the metropolis, more than thirty years ago.



Goebel's Carbon Filament Lamp of 1859.—"Meat Saw" Type.

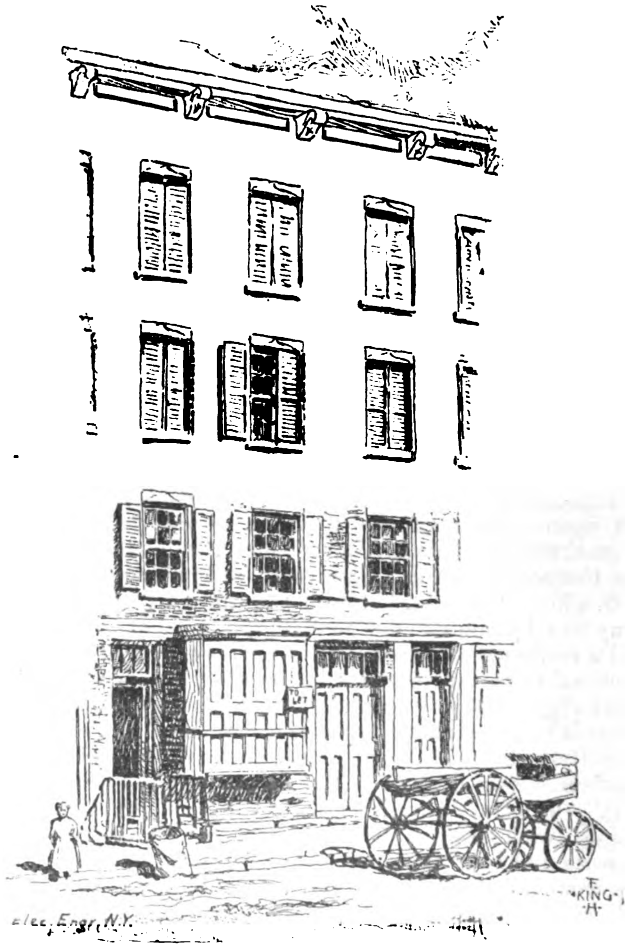
Heinrich Göbel was born in the little village of Springer, a few miles from Hanover, Germany, on the 20th of April, 1818. His father, Friedrich Göbel, was a manufacturer of chocolate, and a man of some prominence in the community in which he lived. He was for a time, about 1819–

20, Consul for the Netherlands in New York. Heinrich received a tolerably good education in the Lutheran Church school of his native village. Having a marked predilection for the study of physical science, he was not content to pursue his father's business, but preferred that of a watchmaker and optician, which he learned after some preliminary experience as an apothecary's assistant, and subsequently carried on on his own account in Springer.

Having in the course of his business, frequent occasion to repair philosophical apparatus for the instructors in the Technological School of Hanover, he soon became much interested in physical research, in which he was aided and encouraged by one Professor Mönighausen, a tutor in a neighboring wealthy family, for whom he made various pieces of apparatus, and who was accustomed to spend a great deal of his leisure time in Göbel's little shop. In 1846 the technical journals of Europe published accounts of the now well-known electric lamp invented by J. W. Starr, of Cincinnati, in which a brilliant light was obtained by the incandescence of a thin rod of carbon enclosed in a Torricellian vacuum. As Göbel was well skilled in the construction of barometers and thermometers, Professor Mönighausen often discussed with him the possibility of making an electric lamp on this principle, and they even went so far as to make some experiments in this direction, but without successful results. During this period Göbel also made galvanic batteries and electromagnetic apparatus, as well as a small magneto-electric machine. He continued, however, to work industriously at his trade, and relates that after having finished a number of clocks, he was accustomed to take them to Hanover on market-day, and expose them for sale in the market place where they were usually soon disposed of.

In 1848, being then thirty years of age, Göbel determined to seek his fortune in the United States. After a tedious voyage of over three months in a sailing vessel, he landed in New York, and in a short time had established himself in his business in a little shop in an obscure neighborhood near the Grand street ferry, where he remained for more than twenty years. He found himself able to support his family in comfort from the proceeds of his business, and in a position to devote considerable time to his favorite occupation of making experiments and inventions. Within three or four years after his arrival in this country, he had constructed a zinc-carbon battery of about 80 large cells, by the aid of which he astonished the neighborhood one dark night by exhibiting from the roof of his house, an electric arc formed between two pieces of carbon. The experiment was, in fact, altogether too successful, for an alarm of fire was sent in, and the department, headed by the historic "Big 6," promptly appeared upon the scene. Being unable to locate the fire, they caused the philosopher to be arrested and carried before a police justice charged with a breach of the peace.

It is possible that the unpleasant results of this experiment may have led Henry Goebel as he thenceforth preferred to be called, to turn his attention in the direction of incandescent lighting. At all events, he undertook to put into practice some of the suggestions of his friend Prof. Mönighausen. He had noticed, in trying to burn a piece of wood out from the ferule of a broken walking stick, that some portions of the wood from which the air was excluded by the ferule were carbonized, and upon testing a piece of this carbonized wood he found it to be a conductor of electricity. This suggested to him the employment of wood fibre, carbonized in a similar manner, for the light-giving conductor of the lamp. Among various woody materials tried, were splinters from a bamboo pipe-stem, which were found to answer admirably. As early as 1855, Goebel had succeeded in making quite a number of lamps, which, by the use of about 30 cells of zinc-carbon battery, emitted, for a short time, a brilliant and beautiful light. A number of these old lamps have fortunately been preserved, and an example of one of the earlier forms, which Goebel called his "meat-saw" lamp, is shown in the accompanying illustration, which has been photographed directly from the lamp in its present condition.

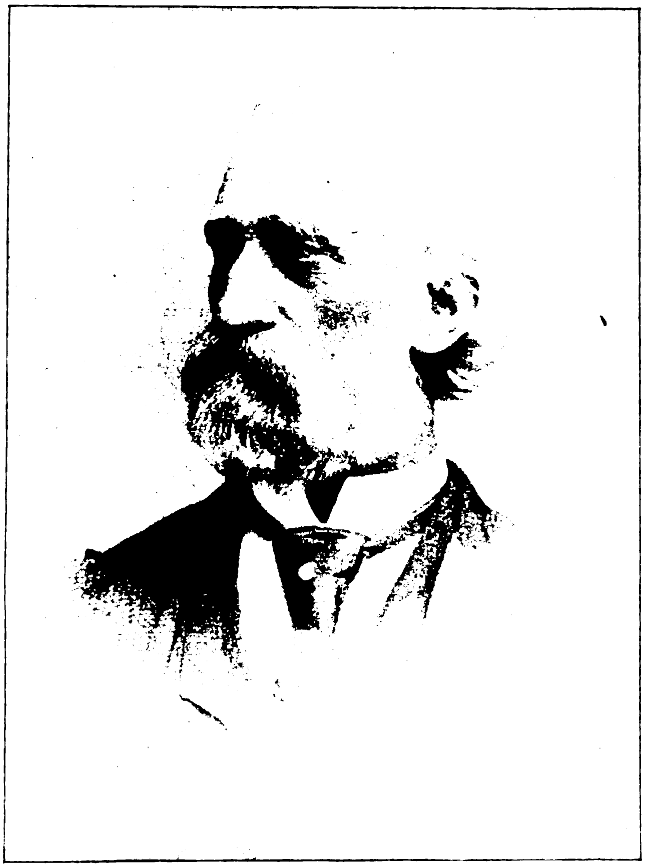


House in Monroe Street, New York, Where Goebel Made His Incandescent Lamps in 1859.

A critical examination of this lamp reveals many surprising anticipations of what have been regarded as distinctively modern discoveries in electric lighting. The chamber of the lamp, which is formed from a piece of glass tube, is now cracked near the bottom, and consequently the vacuum has been destroyed, but that such a vacuum once existed is conclusively proven by the deep concave depressions in the top of the chamber, made by the pressure of the external air when the lamp was sealed off, and before the glass had set. The leading-in wires of this particular lamp are of copper, but both platinum and iron are used in other specimens. An examination of the filament of this lamp under a magnifying glass, shows plainly that it is made of carbonized woody fibre of endogenous growth; undoubtedly bamboo. The filament is $1\frac{1}{16}$ inch long and about $\frac{8}{1000}$ of an inch in thickness, and is elastic and flexible. The ends of the supporting wires are bent into little spirals into which the ends of the carbon filament are thrust, and the joint is secured by a carbonaceous cement; Dixon's stove polish having been employed, according to the statement of the maker. Other lamps examined by the writer, have much thinner leading-in wires, and in some instances the joint has been secured by electroplating it with copper in a bath. Not one essential feature of the modern incandescent lamp is wanting in these examples. There is the filament of carbon, elastic and flexible, first formed and then carbonized, of high resistance and secured to metallic conductors of platinum sealed into the walls of a highly exhausted glass chamber. The familiar smoky discoloration on the interior of the glass, due to the continuous burning of the carbon at high incandescence, is plainly visible in the illustration, proving that the lamp has been put to its intended use, and that the vacuum was, at all events, sufficiently high for that purpose.

Finding the "meat-saw" form of burner liable to give way by the fracture of the filament near its points of attachment, owing to the effects of repeated expansion and contraction, Goebel sought to improve it by the substitution of a spiral or corkscrew shaped carbon, in which he was measurably successful, although but few of these were made, as he soon found that equally good results could be obtained with less trouble by making the carbon in the familiar arch-shape, or as the inventor called it, of the "hair-pin" pattern.

These lamps were exhausted by the process of sealing them, after the carbons and leading-in wires were in place, to the upper end of a glass tube about three feet long, which, being held in an inverted position and filled with mercury, was again inverted while at the same time the mouth of the tube was immersed in a bowl of mercury. The mercury at once descended below the contracted portion of the tube at the top of the lamp, which portion was then softened in a blowpipe flame and sealed off in the ordinary way now practiced.



Henry Goebel

Long before the removal of Goebel from the shop so long occupied by him, which was in 1874, he had been accustomed to set up two or three of these lamps on the show-case and exhibit them to the public, and a considerable number of persons have been found who have a distinct recollection of having seen them burning. One of the lamps is remembered as having been placed in front of the dial of a clock, and arranged with a circuit-closer attached to the mechanism, so as to be automatically lighted during the time of the striking each hour. But the most important public exhibition and use of these lamps, and that which appears to have been seen and remembered by the largest number of persons, has already been referred to in connection with the astronomical telescope. This telescope was quite a large one, having an aperture of some 12 inches, and being 15 or 20 feet in length. It was mounted upon a four-wheeled wagon constructed expressly for the purpose, upon which was carried, besides the telescope, two wooden chests capable of containing 30 large battery cells each, for operating the incandescent lamps. Two or three lamps were lighted simultaneously when the batteries were fresh, and a single lamp could be kept in operation half an hour or more at a time, or until the battery was exhausted. These street exhibitions were given at frequent intervals for two or three years prior to 1860 and also during that year.

With a view of taking advantage of the excitement which at that time filled the public mind with reference to Edison's discoveries, a company was organized in New York, which attempted early in the year 1881, to manufacture and install electric lamps. The person in immediate charge of the lamp manufacture, who was supposed to have gained his knowledge in Edison's laboratory appears to have met with very poor success in his earlier efforts, and thus it happened that a person connected with the company, chancing to hear some rumor of Goebel's work, sent an expert assistant to investigate the matter, who was surprised not a little to find that this obscure artisan was not only an expert manufacturer of carbon filaments, as well as of complete lamps, but that he had quite a stock of these articles in his possession, together with a complete outfit of mercury pumps and other necessary appliances for carrying on the business. As a result of this discovery, Goebel was taken into the service of the company, and at once commenced turning out successful lamps with carbons of unusually excellent quality, and continued to do so until the company fell into financial difficulties and suspended active operations, an event which occurred within a very short time. In view of the very considerable number of persons to whom these facts must at the time have been more or less known, it is certainly very singular that they should have attracted so little attention among those who might naturally be supposed to feel the most interest in the matter.

The fact that Mr. Goebel himself has not pressed his claims to public recognition as an inventor of the incandescent lamp, is, in view of all the circumstances of the case, not difficult of explanation. Although so long resident in the United States, his associations have been mainly confined to the somewhat obscure neighborhood in which has always lived, and to people from his own country. He speaks and understands the English language with some difficulty, and can scarcely read it at all. He never made, so far as it appears, any secret of his methods of constructing and operating the lamps, but as he had constructed his batteries for operating them with his own hands, and had paid the cost of their maintenance out of his own pocket, doubtless no one knew better than he, that so long as it was dependent upon any such source of electricity, the incandescent lamp, interesting and beautiful as it was as a scientific demonstration, was, nevertheless, wholly incapable of extended commercial use. Considering Goebel's circumstances and surroundings, it is perhaps not a matter of surprise that the knowledge of the applicability of the dynamo to this purpose, which only began to attract public attention in the early part of 1880, did not reach him, and that such knowledge should first have come to him through his employment by the lamp company in 1881. He might, it is true, have applied for a patent at that time, but in view of his long continued and repeated use of the invention in public, more than twenty years before, it is, to say the least, a matter of some doubt whether a valid patent could have been granted to him.

A few words respecting the personal characteristics of the man who forms the central figure in this somewhat dramatic episode in the history of the progress of electrical invention, may not be out of place. Although seventy-four years of age, Mr. Goebel's figure is as erect, his eye as bright, and his hand as steady, as a man's in the prime of life. Few can excel him, even at his age, in delicacy, skill and accuracy of touch, in the finer processes of handicraft. Of an unassuming, cheerful and kindly nature, nothing delights him more than to converse upon topics relating to his favorite pursuits of optics and electricity, or to relate with a humorous twinkle of the eye, some of the scientific practical jokes that in younger days he was wont to play upon his unscientific and unsuspecting associates. After a long, industrious and well-spent life, he is passing his declining years in comfort and contentment, in a quiet country village within half a day's journey from the metropolis. The portrait which accompanies this article was taken quite recently, and is a most excellent likeness. The face is that of an observer and student of nature; of a thinker, an inventor, and a mechanician; the very man of all others who might have been expected to have originated that which it has been proven, so far as abundant corroborative testimony can prove, he did in fact originate—the practical electric incandescent lamp.

NEW YORK'S ELECTRICAL SUBWAYS.—IV.

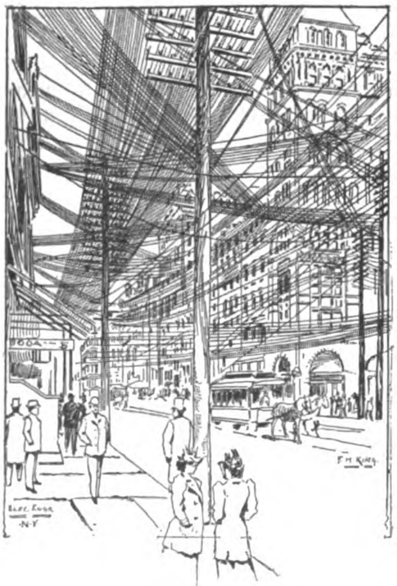
BY

Wm. Maver Jr.

(Concluded.)

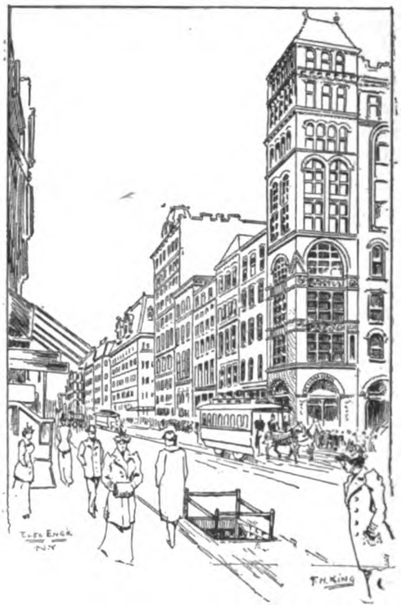
XIII.—COMPARATIVE COST OF MAINTENANCE AND ADVANTAGES OF WIRES—UNDERGROUND WIRES VERSUS WIRES OVERHEAD, IN CITIES.

The question of comparative cost of maintenance of underground wires *vs.* overhead wires, in cities, is obviously a very important one.



Broadway, New York, Before the Removal of Overhead Wires.

The more common items of maintenance of overhead wires in cities are the removing of foreign substances, kite tails, etc., from the wires; trimming foliage; removing ordinary crosses and grounds; removing poles and wires out of the way of scaffolding for new buildings; repairing and replacing cross-arms, insulators, etc.; repairing wholesale damage to lines caused by severe wind-storms, sleet and snow-storms, etc. It is known that the cost of repairing miles of overhead wires after severe storms has frequently amounted to a virtual renewal of the pole line.



Broadway New York, After the Removal of Overhead Wires.

To the cost of those items may be added incidental loss of revenue due to imperfect working, or, as often happens, entire suspension of business during extensive repairs. This applies generally to telegraph, telephone and electric light wires, but, in the case of the latter, there may be added losses due to damage to armatures, etc., caused by breaks, crosses, grounds and lightning. Also may be added, in the case of the latter, the payment of damages on account of injuries and fatalities by direct or indirect contact with overhead electric light wires. In the case of telegraph and telephone service the losses occasioned by fires as a consequence of the contact of overhead telephone or telegraph wires with electric light wires cannot be neglected. Experience has abundantly shown that none of the foregoing items of expense or causes of losses, excepting that of an occasional "ground" or "burn out," has to be considered in the case of properly made and properly laid underground wires.

Perhaps, however, the most important single feature of overhead maintenance in cities as compared with underground maintenance is that of periodical renewal of the pole line. The average life of an overhead wire system, including poles, etc., in cities may be placed at ten years. From present appearances the life of the underground cables in the New York subways will be as long as that of the lead covering. As already mentioned that shows no sign of deterioration.

Apart from the cost of rentals, or the maintenance, of subways, therefore, the cost of maintenance of a well-established underground wire system must clearly be much below that of an overhead system of equal extent. As an instance may be cited the case of an electric light company having no overhead circuits and operating over 25 miles of underground cable, in the service of which, for over a year, there has not been, so far as the underground conductors are concerned, any occasion for a single "shut down," and during which time not a penny has been expended for "patrol" or repairs. Taking the average of several hundred miles of underground electric light wires in this and other cities of which I have knowledge, and including the expenses of testing circuits, repairing an occasional bad joint, or burn out, and of replacing an occasional defective portion of cable, I believe it is a liberal estimate to place the average cost of maintenance of well constructed and well managed electric light underground cables at from five to eight dollars per mile, per annum. Of course, the full economic advantage of underground service cannot be realized so long as any considerable part of the circuits remains overhead, for, in that case, delays and damage incidental to overhead wire service will continue.

The average of maintenance of overhead wires in cities may be placed at about 18 dollars per annum per mile. This is exclusive of rental for roof privileges, etc., and does not include outlay for periodical renewals of the pole line, nor the payment of claims for injuries or fatalities due to whatever cause.

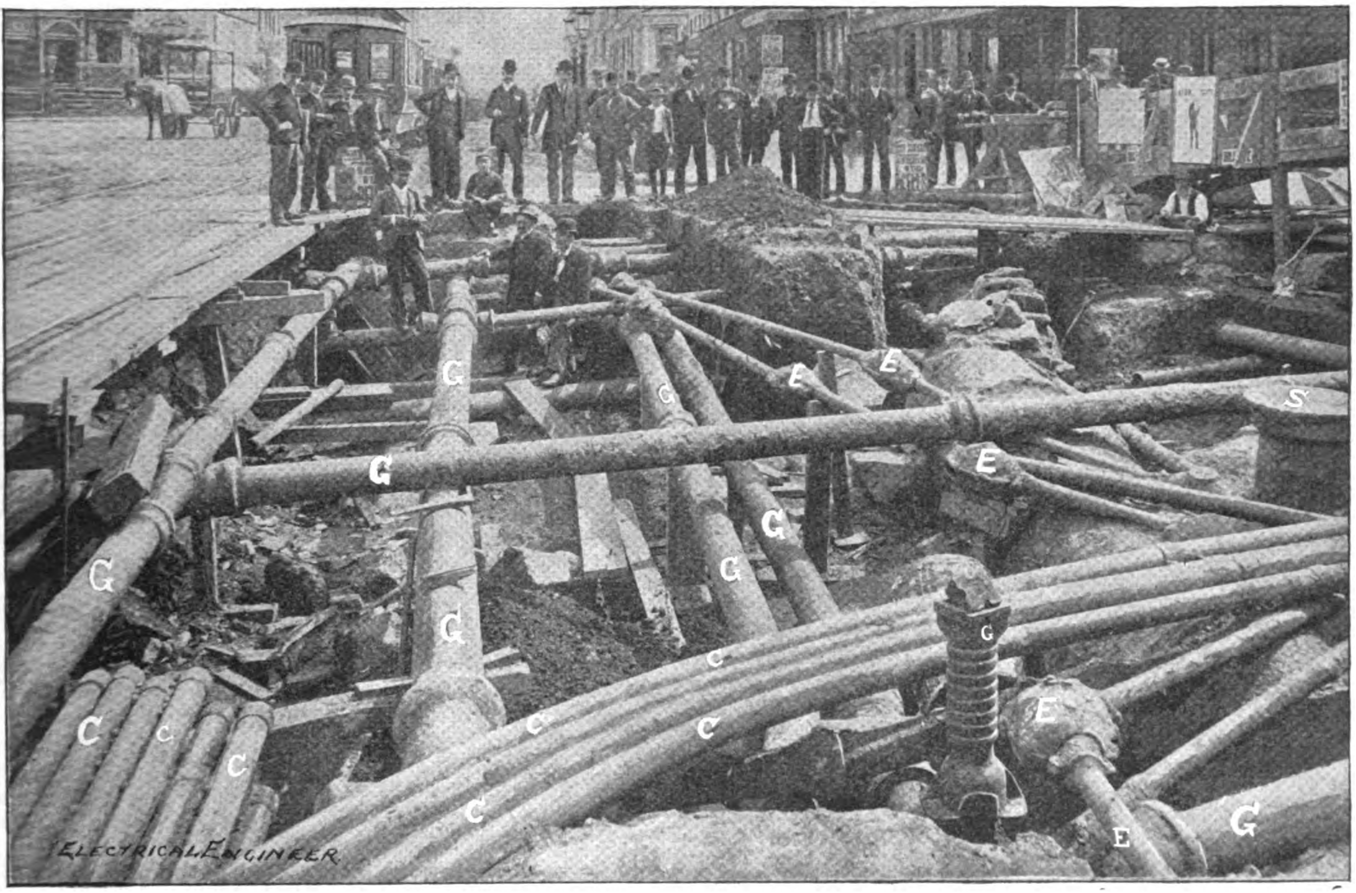
In the matter of public safety the advantage is, of course, all in favor of underground wires. Apropos of this it may be noted that during the year 1888 there were according to the Board of Health, five lives lost by contact with electric light wires, in New York City. There has not thus far been one fatality due to contact with electric light wires in the New York electrical subways since they were built.

The disadvantages of underground service are, it would seem, almost entirely economic, consisting as they do, mainly, of the first cost of conductors, and the cost of construction and maintenance of subways or rentals therefor, and the greater difficulties in the way of reaching districts more or less remote from the line of the subways.

As to reliability of service, it is now generally admitted that the advantage is altogether with the underground conductors.

XIV.—THE DIFFICULTIES OF SUBWAY CONSTRUCTION.

Some idea of the outlay necessary for subway work, of the crowded construction of the streets underground and of the engineering difficulties encountered in the construction of the electrical subways in this city may be gathered from the illustration (Fig. 21) showing the excavations made at the corner of Broadway and Fourteenth street, preparatory to laying the conduit for the cable of the Broadway Surface Railway. The pipes marked G G are water and gas mains; S S are sewer pipes and sewer manholes; E E are Edison conduits; C C are the wrought iron pipes of the electrical subways. The flexibility and utility of the wrought iron pipes for this purpose is shown in the illustration where they are curved to turn from Fourteenth street into Broadway; the pipes having been bent to the proper curvature by the workmen as the construction proceeded. In many cases, as obstructions have been met, it has been necessary to bend these pipes twice within their own length, care being taken, of course, that the bends shall not be so sharp or frequent between manholes as to interfere with the drawing in and out of cables. The cement in which the pipes are laid, the protecting planking, etc., had, it will be observed, been removed before the photograph from which the illustration is made, was taken. It may be added that there are other streets in this city in which pipes, sewers, etc., are even more crowded than is the case at the point illustrated.



EXCAVATION EXPOSING ELECTRIC, GAS, WATER AND SEWER PIPES, 14TH STREET AND BROADWAY, NEW YORK.

XV.—WHAT THE SUBWAYS ACCOMPLISH.

It may not be generally known that the New York electrical subways (apart from those of the Edison system) were designed to meet the following general requirements, namely, that they should afford a ready means of drawing conductors in and out of the ducts as desired; that they should afford easy access for additions, alterations or repairs to conductors, and should provide facilities for the distribution of current, but aside from which it was designed that they should serve only as a mechanical protection for the conductors placed therein, it being deemed impracticable to attempt to construct and maintain subways intended for general use which should serve also as insulators for the conductors. The question of electrically insulating the conductors was therefore left entirely with the users of the subways.

The successful operation of these subways, and of the conductors within them, during the past five years, and at the present time, has shown that they have well fulfilled the requirements laid down, and further, has, in view of the peculiarly crowded conditions of many of the New York streets underground—an illustration of which has been given—the liability to flooding from various causes and the great strains to which the conduits would be subjected by traffic, street excavations, etc., demonstrated, I think, that the material employed and the general construction and design were the best that could have been selected and devised for the purpose.

From an æsthetic point of view, the gain to a city by the placing of electric wires underground may be judged by a comparison of the accompanying illustrations showing the appearance of a portion of Broadway, New York City, near THE ELECTRICAL ENGINEER offices, "before and after."

LAMINATED OR DIVIDED IRON AND OTHER METALLIC MASSES IN ELECTROMAGNETIC APPARATUS.—IV.

BY

Thos D Lockwood

Leon Foucault.

The year 1846 shows us a British patent granted to Edward A. King (a communication, probably from his associate Starr), April 30, No. 11,188, for "Improvements in the Production of Magnetic Electricity," the fourth section of which relates to "A method of preventing the formation of neutralizing currents in the brass or other metallic plates forming the wheel which carries the armatures." A saw cut is made from the edge to the hole through which the armature passes.

In this year, also, Joule has a paper (*Phil. Mag.*, series 3, vol. xxx, pp. 76,225), on the "Effects of Magnetism upon the Dimensions of Iron and Steel Bars," describing experiments, in which he says he employed "fine wires, both of iron and steel, bundles of very fine iron wires, chains composed of copper and iron links, etc."

A patent was taken out in England, by William H. Hatcher, on March 23, 1847, No. 11634, for an improvement in "Electric Telegraphs and Time Keepers," which describes an electromagnet having an iron core built up of laminations. The core is V-shaped, and is made of soft iron, or preferably of "*a series of thin plates of iron placed closely side by side.*"

Daniel Davis, an electrical instrument maker, of Boston, wrote prior to 1848 a most instructive little work entitled "A Manual of Magnetism." It is even now a very readable book. The second edition was published in 1848. Magneto electric induction is discussed in it most intelligently (pp. 264–306), and (pp. 287–291) the action of bundled iron wires when used for induction coil cores is dealt with; as is also the operation of metallic screen tubes, which can be slipped over the core to decrease the spark and shock.

The operation of the bundled core is rightly ascribed to its breaking up of the eddy current circuit, and it is pointed out that the tube, if split, no longer acts as a screen, and also that sawing a solid iron core longitudinally to its centre, in the direction of division, improves its effects.

Isaac L. Pulvermacher patented in England, Dec. 15, 1849, No. 12899, improvements in about all known kinds of electrical apparatus, among which was a magneto machine which he says may be constructed of "flat grooved plates."

The next instance we find is in a British patent, granted to Werner Siemens, April 23, 1850, No. 13062, for "Improvements in Electric Telegraphs," the first of said improvements relating to electro magnets, and consisting in the use, instead of solid iron cores, of iron tubes cut open longitudinally, which, however, have poles formed of large masses of iron having considerable surface.

In a British patent granted to John F. Kingston, Dec. 22, 1852, No. 1134, a variation appears. This patent is for "Obtaining Motive Power by Electromagnets," and it shows electromagnets, the cores of which each consist of several plates of soft iron or nickel. The energizing wire however is wound round each of the individual plates composing the core.

In a "Treatise on Electricity in Theory and Practice," by Aug. de La Rive, (Vol. i, London, 1853), Chap. 5, comprising pp. 347—440 is devoted exclusively to the subject of electro-dynamic induction, which subject is most elegantly, and considering the time, exhaustively treated. On page 81, induction coil cores are considered; the superior advantages of cores made up of insulated soft iron bars are explained, and the principal reason for their use given is, that when they are used, eddy currents cannot circulate. The action of hollow brass or copper cylinders over the core is also discussed.

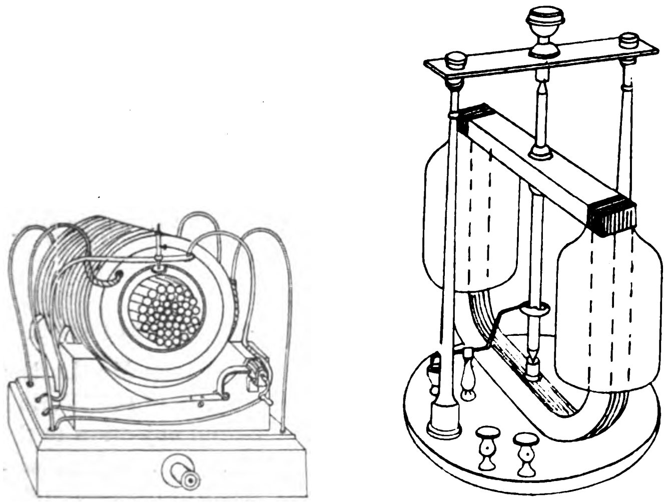
In the same work (p. 388) Bonijol's coil is described, and illustrated and, referring to Fig. 2, it is stated that "the core is not a single cylinder but a bundle of small cylinders covered with an insulating varnish of wax." Considerable space is given in the same work to the researches of M. Dove. The account given of these, is of the highest interest and includes an elaborate discussion on the influence of magnetic masses in bobbins. It well repays a close study and examination, and the action of iron wires—and thick and thin tubes, is fully considered. The reason of these advantages is also analyzed, and the existence of adverse eddy currents proved experimentally.

In 1855, the London, Edinburgh and Dublin *Philosophical Magazine* (Vol. x, 4th series pp. 5 and 6) has a long pape by Poggendorff on "Induction Coils, their Construction and Arrangement," which everyone interested in the subject should read through. It foreshadows quite a number of recent inventions in inductive distribution. In it, together with many other things, Poggendorff shows that in 1855, divided magnetic cores for induction coils were a matter of course; and also that it was not unusual to insulate the divisions. He says with regard to his subtitle—Soft Iron Cores: "Usually this is formed of pretty thick wires *or we may almost say small bars* held together by a common cap, but yet separated from each other by some insulating medium. I have employed such a collection of bars but oftener I used cores of much thinner wire * * *. I found it unnecessary to cover the wires with a varnish, partly because the stratum of protoxide which forms on the surface when heated, is comparatively a bad conductor; partly because the irregularity of the spaces between the wires, none of which remain straight, is more than sufficient to destroy the pernicious continuity in the direction of the periphery of the core."

A British patent was granted on Dec. 4, 1856, to Cromwell F. Varley, No. 3059, which was remarkable for its many sided prevision. It comprised an induction coil having a central core, and an outside casing, both of iron, both finely divided, and joined together in the direction of magnetic continuity to form a magnetic circuit. The central core in the principal form shown, is made up of iron wires which extend out from the ends of the coil, and are lapped backwardly over the outside so as to encase the whole coil practically with iron wire.

A similar construction for induction coil cores was also in the following year advocated in a patent issued in England to our old friend of electric belt fame, Isaac L. Pulvermacher, No. 2411, of Sept. 17, 1857; and laminations of the coil cores of magneto-machines are suggested in the French patent of Berlioz No. 21590 of July 25, 1858.

1859 presents but one instance for our record, but that one is worthy of remark. It is an induction coil with a rotary armature arranged to operate the break. Fig. 3 shows the construction of this coil, which was made by Mr. W. T. Henley, and presented to Henry M. Noad, who describes it. ("Manual of Electricity," Vol. II., pp. 721–722). The machine was in the form of an electromagnet with two spools, and a **U**-shaped core made of a series of **U**-shaped bars of soft iron and bolted together. Over this was first wound a coarse wire to form the primary helix, and then a long winding of fine wire for the secondary. Noad observes toward the end of his description, that "when the ends of the secondary are disunited, the sparks from the primary are large and brilliant; when united they are small and faint." He also in a foot-note gives some brief historical notes referring to the work of Sturgeon, Bachhoffner, Magnus, and Dove in investigating divided cores, and mentions that the work of Magnus and Dove is recorded in Peschel's "Elements of Physics;" (Vol. III., p. 237). Fleming refers to Henley's work in the second volume of his "Alternate Current Transformer," pp. 33–35.



FIGS. 2 AND 3.

A British patent to Chas. W. Harrison, No. 2116 of Sept. 1, 1860, describes an induction coil. The cores described are cylindrical, of iron, and formed either of bundles of wires, or of slotted tubes.

At this point we may take our leave of induction coil cores which are provided merely with unmodified cores made up of fine iron wires, since other improvers—Ruhmkorff, 1851; Stohrer, 1854; Hearder, 1857; Ritchie, 1857, and Gassiot, 1858, did not especially concern themselves with cores. Hearder, however, according to Fleming, says that he improved the iron core by using smaller iron wires than Ruhmkorff.

We may here note that the function of such cores is stated with striking terseness by Prof. S. P. Thompson in his "Elementary Lessons in Electricity and Magnetism," 1st Ed., London, 1882, p. 364, where he says: "The central iron core is for the purpose of increasing by its great coefficient of magnetic induction the number of lines of force that pass through the coils; it is usually made of a bundle of fine wires, to avoid the induction currents, which if it were a solid bar, would be set circulating in it, and which would retard its rapidity of magnetization and demagnetization."

In 1865, Henry Wilde patented in England a magneto-machine having a cast iron armature core having a slot extending three-fourths of its length (British Patent, No. 2762, Oct. 26, 1865).

The Gramme machine which, as every one knows, had a ring armature core composed of an iron wire coiled into a thick hank, was patented in France, No. 87938, Nov. 22, 1869; and in England on June 9, 1870, No. 1668. The latter specification states that the soft iron which is to be magnetized, is given the "form of a solid or hollow ring, cylinder, or other suitable endless shape, constructed of a bundle of iron wires." The Gramme machine has been described in nearly every text book or electro-technical periodical published between the above dates and 1882, and is such a familiar apparatus that no further reference to it is necessary.

In 1870, Sir Wm. Thomson took out a British patent, No. 3069, Nov. 23, for "Improvements in Electric Telegraphs, etc." Speaking of electric engines, the patentee says:—"I diminish the inductive action * * * * and increase the maximum speed and efficiency, by taking advantage of another principle discovered by Faraday, and dividing the soft iron core into parts separated from one another by thin layers of varnish or other non-conductor, in surfaces cutting across the lines of flow of the currents which are induced in the iron when this improvement is not made. One way of executing this improvement is to make the core altogether, or in part, of varnished soft iron wire which, however, has the disadvantage of leaving considerable interstices not occupied by iron. I prefer a smaller number of pieces fitting approximately to one another." This is a remarkable statement. It is, of course, inaccurate in ascribing the principle of division to Faraday; but it is clear that Sir William appreciated the importance of dividing the iron core, and it is curious to note the close resemblance between his language and that of the present day concerning the direction of division.

In 1871, two patents were granted in England to S. A. Varley, Nos. 131, on January 18, and 1150 on April 29, which both show for field magnets a number of magnetized bars piled one upon another, and held apart by being mounted in holes drilled in metal supporting plates.

In 1871, also, we once more hear from Joule, who read a paper before the Manchester Literary and Philosophical Society, March 21, 1871, on "Examples of the Performance of Electro-Magnetic Engines." He concludes by stating that "the actual duty is less than the theoretic; which is owing partly to the pulsatory nature of the current, and partly also to induced currents giving out heat in the substance of the iron cores of the electromagnets; although these last were obviated as far as possible by using annealed tubes with slits down their sides." It should be stated that all of the papers of Joule, to which reference has been made, are easily accessible, since they have been collected and published by the Physical Society of London in two volumes, dated 1884 and 1887 respectively.

"IT GROWS STRONGER."

A WELL-KNOWN electrical engineer in Philadelphia in renewing his subscription for THE ELECTRICAL ENGINEER writes us: "It grows stronger as it grows older."

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Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
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EDITORIAL ANNOUNCEMENTS.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XV. NEW YORK, JANUARY 25, 1893. NO. 247.

AT THE ELEVENTH HOUR.

SINCE the final decision of the Circuit Court of Appeals affirming the validity of the Edison incandescent lamp patent, one after another of the large lamp-manufacturing concerns have been compelled by due process of law to close their doors and dismiss their employés. On Monday, the turn of the Beacon Company, of Boston came, the General Electric Company's counsel having made application to Judge Colt for an injunction. It had been supposed that the granting of this injunction would be a mere matter of course, but when the case came to be called, the audience in the court-room were treated to a genuine surprise, not to say a sensation. The counsel for the Beacon company, armed with a formidable pile of affidavits, proceeded to attack the Edison patent in its most vital point. He produced a number of incandescent lamps, in all material respects the precise counterpart of the Edison lamp, containing a thin filament of carbonized bamboo, with its metallic terminals sealed into an exhausted glass globe; and then proceeded to read from one affidavit after another a great mass of testimony going to show that these self-same lamps had been made at least twenty years before the Edison lamp was ever heard of, by an obscure artisan in one of the humblest neighborhoods of New York and had been publicly exhibited and used by him year after year, within the sight and knowledge of perhaps thousands of people. At first sight, such defence as this, brought forward at this late day, seems absolutely incredible, but the more the evidence is examined, the more does one become convinced, in spite of himself, that the story, at least in its essential particulars, is probably true. Abstracts of the more important of these affidavits are given in our report of the proceedings in another column, and the connected history of the invention, as confirmed by the affidavits, and in part verified from independent sources, is given at length in an illustrated article, hastily prepared for us, by Mr. F. L. Pope.

What will be the ultimate effect of this amazing disclosure upon the Edison patent? Must this patent, too, be compelled to succumb to the adverse fate which has heretofore befallen the patents of Siemens, Gramme, Brush, Gaulard & Gibbs, Sawyer & Man, Weston, and other pioneer inventors in applied electricity? There can be but one answer; if the courts believe the sworn statements of the thirty or more witnesses, who more or less positively identify and fix the date of the Goebel lamp and its public use prior to the breaking out of the rebellion in 1861, then it most certainly seems as if the Edison patent was doomed. Perhaps there is no better off-hand test of the question of anticipation than to inquire whether the alleged anticipating structure, if constructed to-day, would be an infringement of the claims of the patent. In this aspect of the case, the resemblance in the present instant is too clear to require argument. The Goebel lamps are far more nearly identical with the commercial lamp of to-day than they are with the structure described in the Edison patent.

The Court has not granted any injunction as we go to press, but is still in session. In the meantime, by dint of no small effort night and day, and by the unstinted use of the long distance telephone, we are able to present our readers with that which is, whatever its merits and whatever its outcome, one of the most remarkable stories of invention we are acquainted with. Our narrative, and the report of the proceedings in Boston, tell the whole story thus brought to light.

THE WORLD'S FAIR ELECTRICAL FOUNTAINS.

WE publish on another page a letter from Mr. Luther Stieringer, the consulting electrical engineer of the World's Fair, in which he makes a very natural objection to the gross injustice done him by *The Electrical World* in issuing what purport to be views of the electrical fountains that he has designed for the World's Fair, and which appear entirely without his sanction or approval. We also have a little duty to discharge in this connection, in mentioning a few facts. All the drawings published by the *Electrical World were first submitted to us* by the artist who made them, and were accepted, *subject to Mr. Stieringer's approval,* there being some doubt in our minds as to their accuracy. They lay in our office for about a week. On Mr. Stieringer's return from Chicago, they were at once shown him, when he objected to them strongly, and requested us not to use them. The artist was also informed by him that they would not do. He was asked to "turn them to the wall" and to prepare others. They were, however, taken to the *Electrical World,* and peddled there. It seems to us that while artistic imagination may know no bounds, newspaper decency should know some; and that Mr. Stieringer's confidence and reputation have been shamefully abused. As to the quality of the work in these sketches, on which our contemporary spread itself so recklessly, we may remark that the middle fountain of the three is *not* to have any electric light of its own at all, and that the details of the ironwork for the two electric fountains proper are still being determined by the designer and the iron manufacturer!

SOME MECHANICAL AND ELECTRICAL ANALOGIES.

BY

Frederick Bedell & Albert C. Crehore.

No phenomena are so readily comprehended as those which may be compared directly with facts that are familiar, and no reasoning is so quickly grasped as reasoning "by analogy." The analogies between certain mechanical and electrical relations are so striking that when either relations are understood the others follow, and from the laws of mechanics we can readily write those of electricity. The process is a reversible one and the electrician can with equal ease step over into the realms of dynamics. To enable one to reason accurately in this manner and to reach definite results with absolute certainty, it is necessary to give with exactness the fundamental relations of mechanics and electricity.

The following tables are, therefore, given showing the analogies between linear motion, motion of rotation and the electric current. Starting a current of electricity in a circuit is analagous to imparting motion to a body and requires an impressed force. This force must overcome the resistance (electrical resistance corresponding to that of friction) and the inertia of the mass or current. In the case of the electric current this inertia is called "self-induction." A revolving fly-wheel may well represent the flow of electricity, its velocity corresponding to the current, its moment of inertia to the co-efficient of self-induction and the friction to ohmic resistance. A study of the tables will make these analogies more clear.

TABLE I.—LINEAR MOTION.	TABLE II.—ROTARY MOTION.	TABLE III.—ELECTRIC CURRENT.
Notation.	*Notation.*	*Notation.*
1. Time = t.	1. Time = t.	1. Time = t.
2 Distance = s.	2. Angle = ϕ.	2. Quantity = q.
3. Linear velocity = $v = \frac{d\,s}{d\,t}$. $d\,s = v\,d\,t$.	3. Angular velocity = $\omega = \frac{d\,\phi}{d\,t}$. $d\,\phi = \omega\,d\,t$.	3. Current = $i = \frac{d\,q}{d\,t}$. $d\,q = i\,d\,t$.
4. Linear acceleration = $a = \frac{d\,v}{d\,t} = \frac{d^2\,s}{d\,t^2}$.	4. Angular acceleration = $\alpha = \frac{d\,\omega}{d\,t} = \frac{d^2\,\phi}{d\,t^2}$.	4. Current acceleration = $\beta = \frac{d\,i}{d\,t}$.
5. Mass = M.	5. Moment of inertia = I.	5. Coefficient of self-induction = L.
6. Momentum = $M\,v$.	6. Angular momentum = $I\,\omega$.	6. Electromagnetic momentum = $L\,i$.
Frictional Resistance.	*Frictional Resistance.*	*Ohmic Resistance.*
7. Frictional resistance = R.	7. Frictional resistance = R.	7. Ohmic resistance = R.
8. Force to overcome resistance = $F_R = R\,v$.	8. Torque to overcome resistance = $T_R = R\,\omega$.	8. E. M. F. to overcome resistance = $e_R = R\,i$.
9 Energy expended in overcoming resistance in the time $d\,t = d\,W_R = F_R\,d\,s = R\,v^2\,d\,t$.	9. Energy expended in overcoming resistance in the time $d\,t = d\,W_R = T_R\,d\,\phi = R\,\omega^2\,d\,t$.	9. Energy expended in overcoming resistance in the time $d\,t = d\,W_R = e_R\,d\,q = R\,i^2\,d\,t$.
Inertia.	*Inertia.*	*Self-Induction.*
10. Force to overcome inertia = $F^1 = M\,a = M\,\frac{d\,v}{d\,t}$.	10. Torque to overcome inertia = $T^1 = I\,\alpha = I\,\frac{d\,\omega}{d\,t}$.	10. E. M. F. to overcome self-induction $\Big\} = e^1 = L\,\beta = L\,\frac{d\,i}{d\,t}$.
11. Kinetic energy acquired in the time $d\,t \Big\} = d\,W^1 = F^1 ds = Mv\frac{d\,v}{d\,t}d\,t$	11. Kinetic energy acquired in the time $d\,t \Big\} = d\,W^1 = T^1 d\,\phi = I\omega\frac{d\,\omega}{d\,t}d\,t$	11. Energy acquired by the magnetic field in the time $d\,t = d\,W^1 = e^1\,d\,q = L\,i\,\frac{d\,i}{d\,t}\,d\,t$.
12. Kinetic energy = $W^1 = \int_0^v M\,v\,\frac{d\,v}{d\,t}\,d\,t = \frac{1}{2}\,M\,v^2$.	12. Kinetic energy = $W^1 = \int_0^\omega I\,\omega\,\frac{d\,\omega}{d\,t}\,d\,t = \frac{1}{2}\,I\,\omega^2$.	12. Energy of magnetic field = $W^1 = \int_0^i L\,i\,\frac{d\,i}{d\,t}\,d\,t = \frac{1}{2}\,L\,i^2$
Inertia plus Resistance.	*Inertia plus Resistance.*	*Resistance plus Self-Induction.*
13. Total force applied = $F = F_R + F^1 = R\,v + M\frac{d\,v}{d\,t}$	13. Total torque applied = $T = T_R + T^1 = R\,\omega + I\,\frac{d\,\omega}{d\,t}$	13. Total E. M. F. applied = $e = e_R + e^1 = R\,i + L\,\frac{d\,i}{d\,t}$
14. Total energy supplied in the time $d\,t = d\,W = d\,W_R + d\,W^1$; or, $F\,d\,s = F_R\,d\,s + F^1\,d\,s$; or, $F\,v\,d\,t = R\,v^2\,d\,t + M\,v\,\frac{d\,v}{d\,t}\,d\,t$.	14. Total energy supplied in the time $d\,t = d\,W = d\,W_R + d\,W^1$; or, $T\,d\,\phi = T_R\,d\,\phi + T^1\,d\,\phi$; or, $T\,\omega\,d\,t = R\,\omega^2\,d\,t + I\,\omega\,\frac{d\,\omega}{d\,t}\,d\,t$.	14. Total energy supplied in the time $d\,t = d\,W = d\,W_R + d\,W^1$; or, $e\,d\,q = e_R\,d\,q + e^1\,d\,q$; or, $e\,i\,d\,t = R\,i^2\,d\,t + L\,i\,\frac{d\,i}{d\,t}\,d\,t$.

It is to be noted that the fly-wheel or moving mass, in slowing down, gives back its kinetic energy and the wheel is carried on, after the impressed force is removed, until this is entirely consumed in overcoming friction. Similarly, when the current diminishes upon the removal of the impressed electromotive force, the energy stored in the magnetic field is restored to the circuit and the current keeps flowing until the energy is entirely used up in overcoming the ohmic resistance.

These analogies cannot be considered as rigorous proof. The truth of the relations here given for the electric current has been fully established and may be found in the introductory chapter to our work on "Alternating Currents." Other striking analogies will suggest themselves, but space will not permit calling attention to any but the most fundamental ones given above.

PHYSICAL LABORATORY, CORNELL UNIVERSITY.

INSULATED ELECTRIC CONDUCTORS.—XVII.

BY

James Bowstead Williams M.I.E.

Paraffin.—This is a useful ingredient both for insulating and protecting paints. Its function is to impart elasticity, or to assist in doing so, and also durability to paints; but paints containing it dry more slowly than the same compositions *minus* the paraffin do. To use it properly, first melt the other solids and then add the wax, but at a temperature just sufficient to cause it to unite. The combination of solids is then ready to be dissolved in suitable solvents. Paraffin does not decompose as readily by heat when in *compounds* as it does when heated separately; and this is an important feature when compounds containing it have to be boiled for some hours in oil in order to form a perfect paint. If used in too large proportions it will cause "curdling" of paint during the preparation thereof. Solvents, as a rule, dissolve but a small quantity of it, and the majority of the published "receipts" for its use, when in solution for waterproofing, etc., are worthless. Paraffin unites with the most important substances which can be used for paint, but it should rarely exceed more than about five per cent. of the entire weight of the solids.

Beeswax.—This is used in practically the same way and for the same purposes as paraffin, but larger proportions may be used. It does not affect the drying of paints to such a degree as paraffin; it will stand higher temperatures, and impart a greater degree of toughness to the mass than the latter. The best way to use it is to melt with other solids, but it can be added, while in solution, to other solutions, if desired.

India Rubber.—This is used to render paints flexible, or elastic, according to the proportions used. When thus used it should be cut into fine pieces, dissolved in linseed oil, which requires about five hours at a boiling heat, and then added to the other solutions which have been made with a good rubber solvent. Of all the solvents bisulphide of carbon is the best, for it leaves the rubber, after evaporation, in its *natural* state, which is not the case with the solvents commonly used. Further, the bisulphide is a good solvent for most of the resins, asphalts and waxes, and it has this advantage over other solvents in that it can be recovered with but little loss after it has served its purpose.

The bisulphide for rubber paints should be purified. Rubber can be dissolved in rosin, by using a high temperature for five hours, and then dissolved in oil, turpentine, etc., but such paints remain soft for weeks afterward.

Most of the "rubber paints" on sale do not contain a particle of rubber, the elasticity which some of them possess being due to the oxidized oil and oxides of zinc and lead which they contain.

All rubber *paints* dry slowly, but rubber varnishes, *i. e.*, rubber in a volatile solvent, dry quickly.

Glass, silica, and asbestos may often be used with advantage if they are ground to an impalpable powder and thoroughly incorporated in the paints and the braids are not too close or tight.

As before stated, pure linseed oil is the best oil for paints, but be certain that it *is* pure before using. Factitious oils which contain sperm oil and the cheaper seed oils, etc., resemble the genuine oil so closely, even in color and specific gravity, that it is often a difficult matter to know when one does have the genuine.

For *protecting* paints heavy petroleum, alone or with a volatile liquid, is the best solvent.

The oleo resins, gum turpentine and Venice turpentine, can be used to make paints and varnishes more flexible, when first applied, but this effect does not continue owing to the constant changes of these substances by oxidization and evaporation.

The uses to which insulating paints and varnishes, apart from that of saturating the fibrous coverings of wires, are many and various. Cases are continually occurring in practice where additional insulation of wires is required, particularly when used in damp localities and where they are fastened to small glass and porcelain insulators; where parts of apparatus need extra insulation, as well as protection from air and light; where the stems of insulators need coating, and also the ends of some forms of insulated wires. In such cases there is perhaps nothing better than properly selected paints or varnishes to fulfill the required conditions.

In the next article the manufacture of insulated conductors will be considered.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC RAILWAY AND LIGHTING STATIONS.

BY

C. A. Cooley

There seems to be no settled plan of construction and arrangement of electric lighting and power stations. During the first few years of electrical development, when its introduction was considered more or less as an experiment commercially, the matter of first cost entered largely into the calculations of its promoters. Many plants were built with the smallest possible outlay, and advantage was taken of existing and immediately convenient locations. But now the industry has passed the experimental period, and fully demonstrated its ability as an earner of dividends, and is attracting millions of capital seeking investment. Many of the electric generating stations being built to-day are marvels of solidity, and have an air of stability and permanence which impresses one as do the massive banking and business blocks of our large cities.

The problem before the electrical engineer of to-day is not how to make the smallest amount of money cover the most ground, but, with almost unlimited resources of capital, material and generating machinery, how to combine all of these elements to form a beautful and massive whole. The question of future needs and extensions should enter into the calculations as much as ever, and the engineer will save himself much trouble, and his company many dollars, who can so see and plan for the future as not to tie up and disable the capacity for extension in conformity with his original idea.

I have in mind an electric power and lighting station, built a few years ago, which to the observer shows a faulty plan of construction. It is situated on a corner of two streets, with a railroad track forming the third boundary. The engine and dynamo-room is placed on the corner, and the boilers are backed up to the end wall, thus shutting off the natural avenue for extension of the engine and dynamo-room. There is just about room enough between the railroad track and the dynamo-room for the boilers, and, thus built, the plant is capable of extension only by increasing the length of the dynamo-room, as the land is available only in that direction.

A splendid electric railway and power station not yet completed is being constructed for a capacity of 5,000 h. p. and is built near the wharf, with coal bunkers to facilitate the handling of coal, and no expense is being spared to make the plant first class. This station is placed with the end to the street. The engine and generator-room is at the front, with the boilers at the rear, and precluding any extension in that direction. The engine and generator-room will contain ten 500 h. p. tandem compound engines, placed crosswise of the building, and each will be belted directly to a generator. This arrangement, while blocking the natural way of extension, is also faulty as it necessitates very long steam pipes. By placing the boilers at the side of the engine-room, the plant can be enlarged at any time, and it permits the use of comparatively short steam pipes from the boilers to the high pressure cylinders of the several engines.

A careful study of the requirements of a plant before the buildings are begun, will in every case result in benefit to the interests involved.

FIGURES OF STREET CAR TRAVEL IN PHILADELPHIA.

At the annual meeting of the Second and Third Streets Passenger Railway Company president Horace T. Potts submitted a report showing that the road and its branches, exclusive of transfers, carried during the past year 11,944,743 passengers, an increase of 512,111 over 1891. The stockholders present at the meeting were almost unanimous in their expressions favoring the trolley system, and it is understood that at the meeting of the new Board of Directors steps will be taken toward adopting the system on all their lines, including the Frankford branch.

President Jeremiah J. Sullivan, of the Frankford and Southwark Passenger Railroad, and also of the Tenth and Eleventh

Street road, showed to his stockholders that those roads had carried during the past year 22,477,539 passengers, as against 16,267,610 in 1891. There was a very general expression of opinion among the stockholders in favor of adopting the trolley system, and it is thought that at the next meeting of the Board of Directors the matter will be taken up and acted on.

THE RAPID TRANSIT SITUATION.

THE RAPID TRANSIT COMMISSIONERS are still of the opinion that the tunnel plan, suggested by them is the only suitable and effective system for the city, notwithstanding the fact that no responsible bid was made for the franchise when the latter was recently offered for sale, and will, therefore, again offer it at public auction at any time upon information that a proposed purchaser is ready to make a sufficient deposit to justify confidence in his sincerity.

Meantime the Commissioners resolved to ask the Manhattan Elevated Railway to submit plans for proposed extensions of their system to relieve the pressure of urban travel, and the company has responded by suggesting a sufficient number of routes to virtually "double-deck" the city.

The proposed extensions are as follows: From the present Battery Place Station up West street to West Eleventh street, through the latter to Greenwich avenue, thence up Seventh avenue to Forty-fourth street, up Broadway to Fifty-ninth street, up the Boulevard to its intersection with Eleventh avenue at One Hundred and Eighth street, and up Eleventh avenue, through the Washington Heights district to Fort George. A connection of this line with the Sixth avenue line is proposed from the Eighth street station through Greenwich avenue. There would be another connection at Fifty-third street, and it is proposed to extend the Fifty-third street connection west to Tenth avenue and carry a new line up that avenue to the Boulevard line at the intersection at Seventy-first street, which would afford the means of running trains from the Sixth avenue road to that on the Boulevard. The privilege is also asked for a cross-town connection from West street through Watts and Canal to Centre street and down to the bridge, a branch from Sixth avenue at Forty-second street to Fourth avenue and the Grand Central Station, and another from Eighth avenue at One Hundred and Forty-ninth street east to Lenox avenue, down that avenue to One Hundred and Twenty-eighth street, and across to Third avenue. Another extension is desired up Third avenue above the Harlem River to Fordham. In addition to this it is proposed to put a third track on the Second, Third and Ninth avenue lines, with a fourth track through the Bowery.

Mr. Austin Corbin has sent to the Commissioners requesting a conference between the engineers of the Board and those of his proposed tunnels under the East and North Rivers, with a view to a modification of underground plans enabling the two systems to co-operate readily in the transfer of passengers.

DESTRUCTION OF THE PEORIA, ILL., RAILWAY POWER HOUSE.

THE Power House of the Central Railroad Co., of Peoria, Ill., was burned to the ground last week. The engines and dynamos were not running. The engineer and three others were in the building when it caught fire. The fire started in the machine shop and soon spread to the car and power house. The engines and dynamos are total wrecks. There were ten cars in the car house, all of which were burned. The cause of the fire is a mystery, as when it was first discovered the machine shop was all afire; those near tried to put it out with hose belonging to the building but could not, and they were glad to get out alive.

The building was a two-story brick one, only two years old. The loss is estimated as follows:

Power house building	$20,000.00
Engines and Boilers	12,500.00
Machinery	6,500.00
Dynamos and electrical machinery	35,000.00
Cars	30,000.00
Total	$104,000.00

with an insurance of $90,000.00. The company, who operate 20 miles of track, expect to have the Adams street line running this week. They will set up generators at either one of the idle distilleries, or else in the straw board mill, both of which have large engines. The remaining lines will be operated by horse power until current and motor cars can be got.

THE TROLLEY CAR MAIL SERVICE IN ST. LOUIS.

IN THE ELECTRICAL ENGINEER recently appeared an illustrated article on the trolley car mail service in St. Louis. A dispatch from Washington of Jan. 18, now furnishes the following additional information: The report of Postmaster Harlow of St. Louis, made after a two weeks' trial of his street railway postal car service, has been received at the Post Office Department. The St. Louis and Suburban Railway, over which the postal car runs, is a post route eighteen miles long, passes the shipping doors of the Post Office, and has public stations situated directly upon it, one full station three blocks away, and a number of Post Offices upon the road beyond the city limits. Postmaster Harlow says that he has in view a plan by which eight electric cars could wisely be put to this service, by which stations and sub-stations would offer additional facilities for the public and serve as rallying points for carriers, and that the time of twenty or more carriers would thus be saved, and the same men could be put to better use. During the two weeks covered by the report the number of pieces of local mail received and delivered, at a saving of from four to five hours each, has been from three to five hundred daily. Postmaster Harlow regards the trial as eminently successful in every particular.

SAN FRANCISCO STREET RAILWAY EXTENSIONS.

IT is stated that the extensions of the various street railways in San Francisco during the year of '93 will amount to about 85 miles and cost over $3,000,000. The company is devoting much time to the study of electric traction and many of the lines now using horses will adopt the trolley or storage battery. The Kentucky street line is to be extended to Market street and electricity substituted. On Mission street 50,000 yards of grading is to be done, after which the road will be entirely rebuilt, extended to the county line and operated by electricity. It is expected to complete this work in six months. Branches from this and other lines are to be built and will connect with existing and projected cable roads throughout the city. The company say that the trolley will be used for the present, but that they are prepared to adopt any other electric system the promoters of which may prove its practicability.

THE CHICAGO & ST. LOUIS ELECTRIC ROAD.

WE have received the following from the Chicago & St. Louis Electric Railroad Co.:

> "The daily papers have been teeming with stuff in regard to the fight in Congress between the Chicago & St. Louis Electric Road and the General Electric Co., the substance of which is this: The Chicago & St. Louis Electric Road, through Dr. Wellington Adams, and Representative Seth Cobb, of St. Louis, have asked for the right to import certain raw materials for the construction of their generating machinery, and the General Electric Co., through its attorney, E. H. Lewis, is fighting against the granting of this permission
>
> "The stand taken by the Electric Road is this. A multiphase current is to be used, and there are grave doubts as to the ability of the General Electric Co. to produce satisfactory machinery for generating a multiphase current. It has been successfully accomplished on the other side, and for this reason the Electric Road wants to import some of the necessary apparatus; and it surely shows a thoroughness in wanting to get what is no longer an experiment.
>
> "Of course, the General Electric Co. have an axe to grind, and will fight the case to the end. The Chicago & St. Louis Electric Road is in course of construction and will be running on time just the same."

Our own report of the proceedings in Committee, was published last week. The contention that the multiphase apparatus cannot be produced in this country is absurd, even while it may be true that the General Electric Co. has not the specific patent rights.

MISCELLANEOUS.

THE TELEGRAPH AMONG THE MICHIGAN FARMERS.

MR. GEORGE S. TIFFANY, of Tecumseh, Mich., in the January *Engineering Magazine*, says:—

> There is a line in the northern part of Senawee county which was commenced by connecting two farm-houses and has been extended from house to house and village to village until it is now over a hundred miles in length, and connects newspaper offices, doctors' offices, and stores in Adrian, Tecumseh, Clinton, Franklin, Mason, Ridgeway, and Raisin. The farmer keeps up the line across his farm and owns the instrument. One cannot enumerate the benefits it confers, but one which the manager, Mr. Raymond Bowen, of Tecumseh, mentioned to me to-day, it is worthy of special mention. The election returns came in very early from towns on the line and were given to the agent of the Associated Press *in exchange for their despatches*, which were immediately sent over the wire to each farm-house. In receiving news the farmer of Senawee county had an advantage over the business man of New York and Chicago.
>
> "I could not sleep last night," said Mr. Bowen, "for I *lay in bed* listening to the instrument ticking off the election news."
>
> What do you think of that? The Company is named the Commercial Telegraph Co.; but it is a misnomer; it should be named the Farmers' Telegraph Co, for it is such. The system should be extended until every farm-house is bound to every other with cords of steel.

SMASHING LAMP GLOBES AT FAR ROCKAWAY.

THE Far Rockaway, L. I., Electric Light Company is in arms against the wreckers of its lamp globes. The globes afford, after dark, a shining mark for those juvenile marksmen who have no sympathy for corporations and who possess Flobert rifles and bean shooters. The company declares that the expense it is put to for new globes obliterates its profits, and makes some steps to punish the mysterious marksmen imperative. The constabulary has been asked to aid in the matter.

EXPERIMENTS WITH HIGH FREQUENCY ELECTRIC DISCHARGES.

BY

A. A. C. Swinton

THE author has succeeded in passing through his body from hand to hand sufficient electricity to bring the filament of an ordinary 5 c. p. 100 volt incandescent lamp very nearly to full incandescence, or to bring the filament of a 32 c. p. 100 volt lamp to full redness. Practically no sensation was experienced.

The apparatus employed consisted of a large "Apps" induction coil capable of giving 10″ sparks, supplied with current through the ordinary vibrating contact breaker and a resistance consisting of eight 50 c. p. lamps in parallel, from a 105 volt continuous current supply. To the positive and negative terminals of the secondary of the induction coil were connected respectively the inside and outside coatings of three half-gallon Leyden jars, connected in parallel. The disruptive discharge of these jars across an air gap of about a quarter of an inch excited the primary of a simple form of high frequency coil similar to those employed by Mr. Tesla and Prof. Elihu Thomson. The secondary of this coil consisted of 500 turns of No. 26 S. W. G. cotton covered wire wound on a paper tube. Outside this paper tube was a glass tube, upon which the primary, consisting of 10 turns of three No. 16 gutta percha covered wires, in parallel, were wound. The whole coil was immersed in resin oil contained in a wooden trough. The ends of the secondary were connected through small glass tubes, also filled with oil, to brass balls.

On approaching the hand to one of the balls forming the terminals of the oil coil, sparks shoot out from the brush discharge which surrounds it. If the spark is taken on the skin a sharp prick is felt, but on approaching the terminal or touching it with a piece of metal grasped in the hand, or after grasping the terminal itself, practically no appreciable sensation is felt. If the terminal is grasped in this manner with the right hand, sparks will shoot out from the left hand or indeed from any portion of the body, if brought into proximity with another person, a piece of metal, the gas or water pipes or any conducting body. In the experiment referred to, the incandescent lamp was hung by one terminal on a wire connected to earth and connection was made between the other lamp terminal and the coil through the two arms and body by the right hand being brought into contact with one terminal of the oil coil, and a piece of metal grasped in the left hand being approached to the free terminal of the lamp. At the first approach the bulb of the lamp became filled with phosphorescent light, but on reducing the distance between the metal in the left hand and the free lamp terminal, sparks shot out between them and the filament at once became incandescent, the incandescence increasing very nearly to the full normal amount when the piece of metal and the lamp terminal were finally brought into contact.

To produce a similar incandescence of the filament with continuous or alternating currents of ordinary frequency would require about one-fifth of an ampere, and at first sight it would seem that this quantity of current might pass through the arms and body of the operator.

It has been generally assumed that with high frequency currents the current is rendered harmless by reason of the high frequency, in fact, that high frequency renders harmless to the human body currents of a strength that would be dangerous and painful, if not fatal, were the frequency lower. The author is inclined to think that another explanation is possible and that the true fact is, not that high frequency renders harmless a given strength of current that with ordinary frequency would be harmful, but that with high frequency it is possible to obtain effects with exceedingly small currents, that with continuous and ordinary alternating currents can only be obtained by the use of much larger currents.

This hypothesis is probably applicable to many other high frequency effects, but as applied to the above mentioned experiment it is simply this. The lamp filament having a certain definite resistance, with continuous or ordinary alternating currents which pass uniformly or nearly so through the section of the filament, a certain amperage of current is necessary to produce the number of watts required to raise the filament to incandescence. With the high frequency currents on the other hand, as is well understood, the current travels chiefly on the outer surface of the filament, little or none passing through the central portion. The current is in fact merely skin deep. The virtual resistance is therefore very high, as only an extremely small portion of the sectional area of the filament acts as a conductor. There is an ample sufficiency of volts, and though the current is very minute there is a sufficient expenditure of watts to raise the filament to incandescence. The lamp, in fact, ceases to be a 100-volt lamp and becomes, it may well be, a 100,000-volt lamp. As confirming this hypothesis it should be mentioned that while the filament was incandescent, sparks passed between the lamp terminals which were at some distance apart, this being evidence that there was a difference of potential amounting at least to thousands of volts between the two ends of the filament.

Returning to the experiments, several other curious results were obtained. If instead of connecting the lamp to the coil through the human frame a wire was used, the filament became much brighter than in the previous experiment. In fact, it gave considerably above its normal candle power. From this it was evident that the human body offered considerable opposition of some description to the passage of the electricity. In order to form some idea of the amount of this opposition the body was again inserted in the circuit between the coil and the lamp as previously, and the thumbs of the two hands brought near together. Sparks about one-quarter of an inch in length were found to pass between them, evidencing that the two hands of the operator had a difference of potential between them apparently equal to some thousands of volts. When the sparks passed between the hands, or when the wrists were brought into contact so, as it were, to short circuit to some extent the resistance of the arms and body, the filament became very appreciably brighter. It should be mentioned that when the sparks were allowed to pass between the hands very perceptible shocks were felt in the wrists.

Another experiment was to connect one lamp terminal by a wire to the coil, connect the other lamp terminal to earth, and short circuit the lamp through the body by grasping the coil terminal with one hand and a piece of metal connected to earth with the other. The effect of so doing was to reduce the incandescence of the filament to rather less than one-half its normal amount, half of the available current going apparently through the lamp, the other half through the body.

With the lamp terminal connected to the coil, it was found unnecessary to connect the other lamp terminal to earth to produce incandescence, all that was necessary being to touch this lamp terminal with a piece of metal held in the hand. That the incandescence of the filament produced under these conditions was due to the electrostatic capacity of the operator and not to his forming a connection to earth, was evidenced by the fact that it made no perceptible difference whether he stood on the floor or on an insulated stool.

In all the above experiments the second terminal of the oil coil was free and not connected to anything. It was however found that the effect of a second operator touching this terminal, or of connecting it by wire to earth, was to diminish the incandescence of the lamp filament. It was also found that the filament incandesced to a greater degree of brightness when connected as above between one terminal of the coil and earth, than when it was directly connected between the two terminals of the coil. This seems to show that capacity has much to do with the results obtained.

It should also be mentioned that in some of the experiments there was a decided tendency for the filament to vibrate in unison with the contact breaker of the induction coil. In fact in some cases the amplitude of vibration was sufficient to cause the end of the filament to beat against the glass of the lamp bulb.

ALTERNATE CURRENTS OF HIGH POTENTIAL AND HIGH FREQUENCY.—III.

(Concluded.)

BY NIKOLA TESLA.

One of the most interesting results arrived at in pursuing these experiments, is the demonstration of the fact that a gaseous medium, upon which vibration is impressed by rapid changes of electrostatic potential, is rigid. In illustration of this result an experiment may be cited: A glass tube about 1 inch in diameter and 3 feet long, with outside condenser coatings on the ends, was exhausted to a certain point, when, the tube being suspended freely from a wire connecting the upper coating to one of the terminals of the coil, the discharge appeared in the form of a luminous thread, passing through the axis of the tube. Usually the thread was sharply defined in the upper part of the tube and lost itself in the lower part. When a magnet or the finger was quickly passed near the upper part of the luminous thread, it was brought out of position by magnetic or electrostatic influence, and a transversal vibration like that of a suspended cord, with one or more distinct nodes, was set up, which lasted for a few minutes and gradually died out. By suspending to the lower condenser coating metal plates of different sizes, the speed of the vibration was varied. This vibration would seem to show beyond doubt that the thread possessed rigidity, at least to transversal displacements.

Many experiments were tried to demonstrate this property in air at ordinary pressure. Though no positive evidence has been obtained, it is thought nevertheless, that a high frequency brush or streamer, if the frequency could be pushed far enough, would be decidedly rigid. A small sphere might then be moved within it quite freely, but if thrown against it the sphere would rebound. An ordinary flame cannot possess rigidity to a marked degree because the vibration is directionless; but an electric arc, it is believed, must possess that property more or less. A luminous band excited in a bulb by repeated discharges of a Leyden jar must also possess rigidity, and if deformed and suddenly released should vibrate.

From like considerations other conclusions of interest may be made. The most probable medium filling the space is one consisting of independent carriers immersed in an insulating fluid. If through this medium enormous electrostatic stresses are assumed to act, which vary rapidly in intensity, it would allow the motion of a body through it, yet it would be rigid and elastic, although the fluid itself might be devoid of these properties. Furthermore, on the assumption that the independent carriers are of any configuration such that the fluid resistance to motion in one direction is greater than in another, a stress of that nature would cause the carriers to arrange themselves in groups, since they would turn to each other their sides of the greatest electric density, in which position the fluid resistance to approach would be smaller than to receding. If in a medium of the above characteristics a brush would be formed by a steady potential, an exchange of the carriers would go on continually, and there would be less carriers per unit of volume in the brush than in the space at some distance from the electrode, this corresponding to rarefaction. If the potential were rapidly changing, the result would be very different; the higher the frequency of the pulses, the slower would be the exchange of the carriers; finally, the motion of translation through measurable space would cease, and, with a sufficiently high frequency and intensity of the stress, the carriers would be drawn towards the electrode, and compression would result.

An interesting feature of these high frequency currents is that they allow to operate all kinds of devices by connecting the device with only one leading wire to the source. In fact, under certain conditions it may be more economical to supply the electrical energy with one lead than with two.

An experiment of special interest is the running, by the use of only one insulated line, of a motor operating on the principle of the rotating magnetic field enunciated by the author a few years ago. A simple form of such a motor is obtained by winding upon a laminated iron core a primary and close to it a secondary coil, closing the ends of the latter and placing a freely movable metal disc within the influence of the moving field. The secondary coil may, however, be omitted. When one of the ends of the primary coil of the motor is connected to one of the terminals of the high-frequency coil and the other end to an insulated metal plate, which, it should be stated, is not absolutely necessary for the success of the experiment, the disc is set in rotation.

Experiments of this kind seem to bring it within the reach of possibility to operate a motor at any point of the earth's surface from a central source, without any connection to the same except through the earth. If, by means of powerful machinery, rapid variations of the earth's potential were produced, a grounded wire reaching up to some height would be traversed by a current which could be increased by connecting the free end of the wire to a body of some size. The current might be converted to low tension and used to operate a motor or other device. The experiment, which would be one of great scientific interest, would probably best succeed on a ship at sea. In this manner, even if it were not possible to operate machinery, intelligence might be transmitted quite certainly.

In the course of this experimental study special attention was devoted to the heating effects produced by these currents, which are not only striking, but open up the possibility of producing a more efficient illuminant. It it sufficient to attach to the coil terminal a thin wire or filament, to have the temperature of the latter perceptibly raised. If the wire or filament be inclosed in a bulb, the heating effect is increased by preventing the circulation of the air. If the air in the bulb be strongly compressed, the displacements are smaller, the impacts less violent, and the heating effect is diminished. On the contrary, if the air in the bulb be exhausted, an inclosed lamp filament is brought to incandescence, and any amount of light may thus be produced.

The heating of the inclosed lamp filament depends on so many things of a different nature, that it is difficult to give a generally applicable rule under which the maximum heating occurs. As regards the size of the bulb, it is ascertained that at ordinary or only slightly differing atmospheric pressures, when air is a good insulator, the filament is heated more in a small bulb, because of the better confinement of heat in this case. At lower pressures, when air becomes conducting, the heating effect is greater in a large bulb, but at excessively high degrees of exhaustion there seems to be, beyond a certain and rather small size of the vessel, no perceptible difference in the heating.

The shape of the vessel is also of some importance, and it has been found of advantage for reasons of economy to employ a spherical bulb with the electrode mounted in its centre, where the rebounding molecules collide. It is desirable on account of economy that all the energy supplied to the bulb from the source should reach without loss the body to be heated. The loss in conveying the energy from the source to the body may be reduced by employing thin wires heavily coated with insulation, and by the use of electrostatic screens. It is to be remarked, that the screen cannot be connected to the ground as under ordinary conditions.

In the bulb itself a large portion of the energy supplied may be lost by molecular bombardment against the wire connecting the body to be heated with the source. Considerable improvement was effected by covering the glass stem containing the wire with a closely fitting conducting tube. This tube is made to project a little above the glass, and prevents the cracking of the latter near the heated body. The effectiveness of the conducting tube is limited to very high degrees of exhaustion. It diminishes the energy lost in bombardment for two reasons: First, the charge given up by the atoms spreads over a greater area, and hence the electric density at any point is small, and the atoms are repelled with less energy than if they would strike against a good insulator; secondly, as the tube is electrified by the atoms which first come in contact with it, the progress of the following atoms against the tube is more or less checked by the repulsion which the electrified tube must exert upon the similarly electrified atoms. This, it is thought, explains why the discharge through a bulb is established with much greater facility when an insulator than when a conductor is present.

During the investigations great many bulbs of different construction, with the electrodes of different material, were experimented upon, and a number of observations of interest were made. It was found that the deterioration of the electrode is the less, the higher the frequency. This was to be expected, as then the heating is effected by many small impacts, instead of by fewer and more violent ones, which quickly shatter the structure. The deterioration is also smaller when the vibration is harmonic. Thus an electrode, maintained at a certain degree of heat, lasts much longer with currents obtained from an alternator, than with those obtained by means of a disruptive discharge. One of the most durable electrodes was obtained from strongly compressed carborundum, which is a kind of carbon recently produced by Mr. E. G. Acheson. From experience, it is inferred, that to be most durable, the electrode should be in the form of a sphere with a highly polished surface.

In some bulbs refractory bodies were mounted in a carbon cup and pushed under the molecular impact. It was observed in such experiments that the carbon cup was heated at first, until a higher temperature was reached; then most of the bombardment was directed against the refractory body, and the carbon was relieved. In general, when different bodies were mounted in the bulb, the hardest fusible would be relieved, and would remain at a considerably lower temperature. This was necessitated by the fact that most of the energy supplied would find its way through the body which was easier fused or "evaporated." Curiously enough it appeared in some of the experiments made, that a body was fused in a bulb under the molecular impact by evolution of less light than when fused by the application of heat in ordinary ways. This may be ascribed to a loosening of the structure of the body under the violent impacts and changing stresses.

Some experiments seem to indicate that under certain conditions a body, conducting, or non-conducting, may, when bombarded, emit light, which to all appearance is due to phosphorescence, but may in reality be caused by the incandescence of an infinitesimal layer, the mean temperature of the body being comparatively small. Such might be the case if each single rythmical impact were capable of instantaneously exciting the retina, and the rythm just high enough to cause a continuous impression in the eye. According to this view, a coil operated by disruptive discharge would be eminently adapted to produce such a result, and it is found by experiment that its power of exciting phosphorescence is extraordinarily great. It is capable of exciting phosphorescence at comparatively low degrees of exhaustion, and also projects shadows at pressures far greater than those at which the mean free path is comparable to the dimensions of the vessel. The latter observation is of some importance, inasmuch as it may modify the generally accepted views in regard to the "radiant state" phenomena.

A thought, which early and naturally suggested itself, was to utilize the great inductive effects of high frequency currents to produce light in a sealed glass vessel without the use of leading-in wires. Accordingly, many bulbs were constructed in which the energy necessary to maintain a button or filament at high incandescence, was supplied through the glass either by electrostatic or electrodynamic induction. It was likewise easy to regulate the intensity of the light emitted by means of an externally applied condenser coating connected to an insulated plate, or simply by means of a plate attached to the bulb which at the same time performed the function of a shade.

A subject of experiment, which has been exhaustively treated by Prof. J. J. Thomson, has been followed up independently by the author from the beginning of this study, namely, to excite by electrodynamic induction a luminous band in a closed tube or bulb, In observing the behavior of gases, and the luminous phenomena obtained, the importance of the electrostatic effects was noted and it appeared desirable to produce enormous potential differences, alternating with extreme rapidity. Experiments in this direction led to some of the most interesting results arrived at in the course of these investigations. It was found that by rapid alternations of a high electrostatic potential, exhausted tubes could be lighted at considerable distance from a conductor connected to a properly constructed coil, and that it was practicable to establish with the coil an alternating electrostatic field, acting through the whole extent of a room and lighting a tube, wherever it was placed in the same. Phosphorescent bulbs may be excited in such a field, and it is easy to regulate the effect by connecting to the bulb a small insulated metal plate. It was likewise possible to maintain a filament or button mounted in a tube at bright incandescence, and in one experiment, a mica vane was spun by the incandescence of a platinum wire.

It is hoped that the study of these phenomena, and the perfection of the means for obtaining rapidly alternating high potentials, will lead to the production of an efficient illuminant.

THE UTILIZATION OF NIAGARA.—II.

(*Concluded.*)

BY PROF. GEORGE FORBES, F.R.S.

Having now given some account of the hydraulic part of the work, and of the engineering construction, it will be well to say something about the manner in which this power is to be distributed and utilized. The directors of the company were very anxious that the best advice possible should be obtained on this point, and, in 1890, they appointed a Commission, which sat in London, under the presidency of Lord Kelvin, assisted by Professor Mascart, of Paris, Colonel Turrettini, of Geneva, and Professor Coleman Sellers, of Philadelphia, to consider the various proposals which had been made by several engineers and manufacturing firms who had been specially invited to submit projects for the utilization and distribution of the power developed at Niagara Falls. Professor Unwin, who is now considering the problem of dealing with the hydraulic engineering for utilizing the Horseshoe Fall, on the Canadian side, was the secretary. Among the projects submitted, the two most promising means of distribution were compressed air and electricity, but the further inquiries which have proceeded since the Commission was closed have resulted in the decision to adopt electricity. At one time it was thought that a large number of mills would be worked on the same plan as the paper company spoken of above—that is to say, by driving the mills directly by turbines in separate wheel pits having access to the great tunnel—but the expense of digging separate wheel pits for every mill is serious, besides that, this plan would involve a considerable extension of the tunnel; and it has been considered best, not only for transmission to a distance, but also for most of the local distribution, to employ electricity for supplying the power to the different mills and workshops. The question of using compressed air was seriously considered, but it also gave way in convenience and economy to electricity.

Now, when I come to speak of the electrical part of the scheme I feel some diffidence, because we are at the present moment on the eve of settling the type of machinery to be used. I have before me for consideration more than 20 distinct plans of the 5,000 h. p. generators which may be used. Some of these are for continuous currents, others for alternating currents, and while I naturally have definite views as to which of the plans proposed is the most practical, I confess that, even at this time, I have an open mind which would be free to accept anything which seems more valuable than the best design we have received as yet. Of one point I may assure you most definitely, and that is, that there is not the slightest difficulty in making this work successful from an engineering as well as from a commercial point of view. My difficulties have consisted chiefly in the number of different ways by means of which it was possible to attain the results required. The types of machine which have been proposed vary in many essential features, and in none more than in the important item of the weight of the revolving part, which varies in these designs from 7 or 8 tons up to 60 tons; but it is quite remarkable that in a science of comparatively recent growth, as in the distribution of power electrically, there should be so few differences of opinion as to the means to be adopted, and the character of the machinery to be used. This is the more remarkable when I contrast it with any ordinary engineering machinery which is the growth of a hundred years or more. Even in the matter of such a common-place article as a steam boiler, the differences of view which exist among mechanical engineers are quite surprising, for it would have been supposed that, after so long a period of practical experience, the views of all engineers would have been brought into harmony by this time. The question of broad and narrow gauge has equally disturbed the equanimity of engineers, and in every department of steam engineering we find the widest differences of views existing among engineers. It is consequently a little surprising that electricians are so nearly agreed as to the methods and machinery to be used.

There are two great classes into which this problem may be divided, depending upon the use either of continuous or alternating currents. Both of these are thoroughly available for the purposes under consideration, and each has some special advantages. A few years ago there was a certain dread of the use of alternating currents among a certain class, but this has gradually disappeared. Heated arguments were formerly used on both sides, but at the present day it is possible for all independent engineers to discuss these matters on a basis of pure reason, and no serious differences arise when the relative advantages of the two kinds of current are discussed among capable engineers. The continuous current has the advantage that the dynamos of this kind have been made in larger quantities, and that we can at a moment's notice procure on the market a motor of any moderate size. They can also be coupled in series or in parallel with the utmost facility. The alternating current dynamo has the advantages that it employs no commutator—a source both of expense and of risk in a continuous current machine, and also that the alternating current can be transformed up to a higher, or down to a lower pressure. A low pressure dynamo is a machine of more solid construction than a high pressure one. When the current has been created at low pressure, it can be converted by a transformer into high pressure, and so carried economically along fine wires to a distance where it can be reduced in pressure by a second transformer, and supplied to motors in a perfectly safe condition. With the continuous current, on the other hand, the motors must be of the same high pressure as that which is used upon the line, even if we adopt the combination of a motor and dynamo as a transformer for supplying low pressure current to workshops. Such an apparatus is far more objectionable than the alternating current transformer, which is at rest during the whole time of its action. It is also more expensive than the latter. When the distance to which the power has to be transmitted is short, it may become more economical to use low pressure and thick conductors instead of high pressure with transformers and thin conductors, but the distance to which this advantage extends is very short. The experiments which were made last year between Lauffen and Frankfort, show that we need not have the slightest fear about using so much as 20,000 volts in the transmission between Niagara and Buffalo, and if a subway be constructed over this distance in which to carry the conductors, we need not fear any climatic troubles, and inspection will be so easy that the conductors will always be in good order.

In 1890 I laid before the Commission my views as to the manner in which the desired results might best be obtained, and expressed myself at that time in favor of the use of alternating currents, most specially for the transmission to Buffalo, and I think that on this point there are no two opinions at the present time, although considerable opposition to this view was shown at the earlier date.

Alternating current motors may be divided into two classes, synchronizing and non-synchronizing motors. The former are mechanically identical with the alternating current generator, and revolve at constant speed governed by the speed of the generating machine. Of the latter class those best known are those depending for their action on principles discovered independently by Tesla and Ferraris. The former class have been in considerable use both in Europe and in America on what may be spoken of as a large scale, and they are found to equal continuous current motors in efficiency. The latter class, especially those which are described as rotary phase motors, have been gradually developed since I related my experience with them to the Commission two years ago, and their efficiency, as guaranteed by the makers, now amounts to 90 or 92 per cent. Continuous current motors have been used to so great an extent, and more especially in electrical tramways, that it is unnecessary to enlarge upon their capabilities. There are many other kinds of motors which are available, but it would be tedious if I were to describe to you the action of all these different varieties. I will only mention one more system, which may be described as a combination of alternating and continuous currents, and which promises to do important work in the future. In the ordinary usage of a continuous current, the dynamo originally generates an alternating current, and the commutator is applied to the dynamo to convert it into a continuous current, and this procedure prevents us from taking advantage of that valuable adjunct, the transformer. Many engineers are now working at a plan whereby the commutator, instead of being put upon the dynamo, is put at the other end of the line after the high pressure alternating current has been reduced in pressure, and we are thus able to distribute a low pressure continuous current to the motors at the distant station, while we have been using a high pressure alternating current over the line. I will not say at present which of the numerous methods which are available to us are most likely to be adopted. I have said enough to show you that we have ample means at our disposal to establish a thoroughly successful plant from an engineering point of view. As to the commercial side of the question I must satisfy myself with stating to you in general terms that after having worked out the cost in every one of the different methods which have been proposed, I have no hesitation is assuring you that the cost at which a horse-power per annum can be sold, either in the neighborhood of Niagara Falls or at Buffalo, is such as to make the enterprise certain of success from a commercial point of view.

Hitherto I have sketched out the general engineering questions which have arisen, but beyond that there is a great deal as to the policy which has been adopted by the directors of this company. Those who have taken the most active part in its development are Mr. E. D. Adams, the president, Mr. L. Stetson and Mr. E. A. Wickes, vice-presidents, and Mr. W. B. Rankine, secretary and treasurer. The consulting engineers include Professor Coleman Sellers, whose knowledge and experience of all classes of machinery is so well known; Mr. Bogart, who has had the construction of large engineering works under his charge; and Mr. Clemens Herschel, who has devoted his life to the development of hydraulic enterprises; while Col. Turrettini acts as foreign consulting engineer, my own position being that of electrical consulting engineer. Mr. Burbank is the resident consulting engineer, and Mr. Albert Porter the resident engineer.

The directors of the company have shown great foresight in a great deal of their work. The capacity of the present tunnel is sufficient to provide 100,000 h. p. applied to the turbines. Rights of way have been obtained for another tunnel of the same capacity on the American side. On the Canadian side a concession has been granted for utilizing the Horseshoe Falls, and the extent to which these will be used may probably reach 250,000 h. p. Thus we have in all 450,000 h. p. available.

Early in the history of this concern, before it had reached anything like a practical stage, about 1,500 acres of land had been bought up in the neigborhood of Niagara Falls, and it is intended to develop this land as much as possible so as to make a great manufacturing centre. A great number of applications for power have already been received, and it becomes perfectly evident that the establishment of each separate industry will bring to the neighborhood a large number of new industries. Thus we expect very shortly to have a copper refinery for electrolytic processes. This will naturally bring wire manufactories to the spot. Electric cables will also be made there, where the wire can be obtained cheapest. The wants of the company alone are sufficient to require the establishment of an electrical factory, and the facilities for transporting machinery by land or water will be such as to make it an important centre for the manufacture of large electric machinery, either for lighting, for traction, or other purposes. And so it appears likely to proceed, the success of one industry leading to the establishment of another, until the whole land of the company, and much more besides, is used up in the raising of what may eventually become the greatest manufacturing centre of the United States.

In order to give facilities of transport to those who establish themselves here, ample wharfage accommodation will be established, a matter which is comparatively easy, since the company owns several miles of river frontage. With the same object in view a terminal railway has been built, and is now at work, connecting the principal streets belonging to the company with the three great lines of railroad which pass beside it. Contracts have already been given out for the construction of laborers' houses, and before long this part of the new city will have made sensible progress.

The company has also undertaken the water supply of the city, including the old part, which was insufficiently supplied, and they are also dealing with the matter of sewage.

Altogether, I may briefly state the impression which has been thrust upon me by an examination of the plans and works of the company, in saying that they have taken a most comprehensive view of the situation, and have proceeded up to the present with an amount of caution and foresight that cannot but augur well for the future of the enterprise.

I have often been asked whether the diversion of the waters of the Niagara River will affect the picturesque character of the Falls. I do not think it will. The present tunnel will divert 100,000 h. p. The company has rights for constructing a parallel tunnel of like capacity. The Canadian concession will allow of 250,000 h. p. being utilized. Thus we have a total of 450,000 h. p. which may be used, being about 12 per cent. of the total water. These are the utmost limits to which the company can divert the river, and in their American charters they have, unsolicited, limited their demands to 200,000 h. p. on that side of the river. I do not think that a difference of 12 per cent. in the flow of the water would be noticeable to the tourists who come to see the Falls. But I think it improbable that all this power will be utilized for a long time to come. If we put the value of a horse-power day and night at only £5 per annum, the above output represents an income of £2,450,000 per annum.

With regard to ruining the amenities of the place, we need not fear anything from the action of the company, but this has already been largely done by the Government of Ontario, to its lasting disgrace, for the sake of a paltry addition to their revenue. By the energy of Lord Dufferin, the Canadian banks of the river near the Falls were lately reserved for the people as a park, called Victoria park. The Americans at the same time reserved the American shore and Goat Island for the people. Victoria park was one of the loveliest spots on earth, where you could enjoy the scenery in quiet. This is all spoilt now. A concession has been granted for a railway, which has now been built with almost indecent haste. It goes along the edge of the cliff where formerly one could walk in peace and safety. It goes through the lovely Dufferin Islands, where massive iron bridges have been built for a double track of railway, and thus for the sake of a paltry annual income the Government of Ontario has mortgaged the benefits conferred on the world by Lord Dufferin.

In concluding this paper, I must express my admiration for the policy of forethought displayed by the directors of the company that is undertaking the harnessing of Niagara. They traveled all over the world to see what had been done already in transmitting power, and before settling on any plans they spared no expense to get the best advice through the Commission they appointed. The same forethought was shown in securing the rights of way for two tunnels on the American side and getting the control of the Canadian concession; also in buying up the land which is to be the site of the new city. As another example of this spirit, I may say that when I was appointed as their electrical consulting engineer, I was instructed to visit on their behalf and report to them on any works in any part of the world that seemed to me likely to be of use in giving us more information about the distribution of power by electricity. I am sure that you will all agree with me that a work of this magnitude and importance, commenced and carried out with so much practical wisdom deserves to succeed, and I trust that many of you when on your way next year to visit the Chicago Exhibition will be able to stop at Niagara Falls, and see for yourselves the way in which these vast waste forces are being harnessed to the service of man.

ELECTRICAL RECORDING METERS.[1]—I.

BY CARYL D. HASKINS.

A BRIEF history of the evolution of the electric meter would be very appropriate, but repetition is odious, and I beg to refer all who are interested in the early history and genealogy of the meter to that most interesting and complete paper on this subject read before the Institute[2] by Mr. George W. Walker, May, 21, 1891.

The earliest meter patent was granted in 1872 to Mr. S. Gardner, of New York City, and the principle of a magnetic or electro-magnetic release for a simple clock movement, is preserved in two or three so-called time-counters to-day, and is doubtless very useful for many purposes; as for example in the Spaulding clock for registering the hours of use of a motor, or other similar devices for registering the hours of use of arc circuits. These devices I shall neglect; they are not meters within the true sense of the word, and their simplicity is obvious.

Before undertaking any description, a few words may be appropriately devoted to the question of the unit by which it is most desirable to measure electrical power in use.

The ampere has been, perhaps is to-day, the popular unit for the measurement of electricity supplied; yet, on careful consideration, how very meaningless for work of this kind, is the ampere unit. Had we but one standard voltage in use for lighting and for power, and for other purposes, no unit could be better than the ampere-hour for meter measurement; but unfortunately or fortunately, as the case may be, there is scarcely a potential, between 5 and 2,000 volts, which does not more or less imperatively call for measurement by meter to-day, and if the ampere unit is to be retained, then it will become necessary to reconcile ourselves to the use of an endless number of constants, or to a still more endless schedule of ampere-hour rates.

We wish to measure power delivered; in fact we wish to know how much coal a group of lamps is consuming. This points directly to the watt, and I venture to assert that careful consideration will invariably show that the watt is the only true unit for the measurement of electricity by meter. Unless, perchance, we adopt the cubic foot, as has at least one central station in the United States; a very amusing but equally practical demonstration of American ingenuity.

The earliest successful meters if we consider classes rather than individual instruments, were the chemical meters, closely followed by thermo-meters. The chemical meter is obviously capable of giving most accurate results; in fact with proper manipulation, it is very doubtful whether any measuring device, which has up to to-day been designed, could more correctly sum up passing power. It is in the manipulation and care which such meters require, that their fault lies—if fault there be.

It will be useless for me to waste the time and patience of my kind listeners, by describing to them the eminently successful and generally popular Edison chemical meter, and I will not attempt to do so.[3] An electro-plating bath in its meter form as generally used, does not, however, give a dial indication, and the consumers ask for a dial indication almost invariably, unless they have already become thoroughly familiarized with Edison meters as used by many large Edison stations. Many very ingenious and some quite successful attempts have been made to actuate a train of gears by the electro-deposition of an electrolytic bath,[1] such as the Edison "walking-beam" meter. Again we have a modification of the same device in the form of a wheel bearing a number of electrodes, and on the same principle setting up continuous rotation. It should be noted that in this first digression from the chemical meter, we at once meet with the prime factor of difficulty in all motor meter construction—that of friction, which, if uncompensated, must invariably introduce more or less serious error.

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[1] Abstract of a paper read before the American Institute of Electrical Engineers, Jan. 17, 1893.

[2] *Transactions*, A. I. E. E., vol. viii, p. 351.

[3] See Jenks on the Edison Chemical Meter, *Transactions*, A. I. E. E., vol. vi., p. 26.

Another form of self-registering electrolytic meter has a cathode plate suspended from a spring-balance, an ordinary sensitive spring weighing machine, and the heavier the cathode grows, so much greater is the registration of the spring indicator. This device is perhaps preferable to the reciprocating movement, but is limited in the capacity of the spring, and probably lacks sensitiveness to small amounts, being dependent of course solely upon the nicety of construction in the spring-balance.

Mercury has at times been employed in the construction of electrolytic meters, and with at least moderate success, for with a mercury anode and a cathode of the same or other material, a record easily measured may be obtained, and such a meter may even be made self-registering in a graduated tube or by half a dozen other more or less simple means.

Another form of chemical meter formerly quite popular among inventors, depended for its registration upon the decomposition of water, generally acidulated water, and sometimes upon the decomposition of more volatile substances. This class of meter may very properly be divided under two heads: First, those meters simply dependent upon the measurement of the gas developed by the decomposition of water through any gas registering device. In fact, we may say that such meters are mere decomposing baths connected to a gas meter. There are some devices of merit which may be classed under this head, but the principle is probably not commercial, for we have nothing very successful of this kind in use to-day.

One of the more ingenious meters of this kind provides a diagonally placed rotating wheel with pockets; the decomposition takes place directly under each pocket progressively, and as the air pocket fills with gas, the wheel rotates sufficiently to free this gas at the surface of the fluid, bringing another pocket into place. Others have a rising and falling diaphragm like the popular gas meter, and still others, a delicately poised air fan over a minute aperture. This last device is obviously most inefficient.

The second group of meters under this classification brings us to the thermo-meters; a typical group containing a few meters of more or less pronounced merit.

Those thermo-meters depending upon volatilization of a fluid, generally have two or more sealed bulbs partly filled with some volatile fluid, as, for example, naphtha or ether. When two such bulbs are used, they have generally been mounted on a walking-beam mechanism combined with a pole-changer; each bulb containing some kind of a rheostat or heat developing device dependent for its heat on the current passing through the meter, the two bulbs communicating with one another. To be successful, such a device must be very sensitive, and to be sensitive, the construction must be of a more or less expensive character, and so delicate as to be to a greater or less degree prohibitive. Like the walking-beam meters just described, instruments of this class have been designed with a number of bulbs mounted on a rotating wheel; the same actuating principle holding true for all such devices.

Another ingenious form of thermo-meter, no longer in any sense a chemical meter, is an instrument dependent for its action upon the heat in a confined but circulating atmosphere. Thus a rheostat dependent for its heat upon the amount of current passing, is so arranged as to heat a body of air, which, by the peculiar construction of its receptacle, at once commences to circulate more or less rapidly, dependent upon the heat. It is obvious, that if a delicate air fan, a screw propeller in fact, be suspended over such a circulation of air, its speed would increase with the speed and volume of circulation, and one of the most ingenious and most interesting meters that it has ever been my good fortune to see, is the Forbes meter,[2] constructed on this plan. But here friction is the most serious consideration; the torque obtained in this manner being necessarily small.

While the Forbes meter cannot perhaps be properly considered as a motor meter in the true sense of the word, it still must be classed as such in a certain sense, and I think it may safely be accepted as an axiom, that to be successful in practical operation, a motor meter of any kind must be of high torque, for it is only by the combination of high torque and compensated friction that accurate results can be obtained on light loads. I might say that almost any one can build a meter which will record fairly accurately on heavy loads; the difficulty is to build a sensitive and accurate meter for very light loads down to one lamp.

Another ingenious and quite positive form of heat meter consists of two metallic rods, or in some cases of two bi-metallic rods, somewhat similar to an ordinary thermostat; such meters being in fact a simple application of the thermostat principle to a recording device. Two rods of this kind may be placed vertically, one under each end of a walking-beam mechanism, the familiar pole-changing device being again brought into play to throw the current first through one rod and then through the other. The character of the walking-beam must be such, that only a slight movement is needed to actuate the recording mechanism and also the pole-changer. I think no comments are needed on such a device as this; it probably lacks sensitiveness to a marked degree and it has other objections which are sufficiently apparent.

Probably better than this is the system of bi-metallic rods with one contracting and one expanding side, which bend to right and left, or up and down, with a rapidity dependent upon the strength of the current, a pole-changer of course being used as before. The method of actuating a train of gears by this system is comparatively simple, and not open to as many objections as the device just described,

I have neglected to state heretofore that the bulk of the thermo-meters are actuated on the shunt principle. It is obviously out of the question to operate a pole-changer by means of a meter, which shall cause one to break the full current passing to the lamps. As a rule, a very small portion of the total current is carried through the meter around a positive shunt. Instead of shunting the current, this device has at times been applied to alternating work by the introduction of a kind of transformer, which takes a few turns of wire in series with the lamps and transfers the energy through a secondary to actuate the meter; thus the meter is not on the lamp circuit at all, but on the independent secondary. But this intervention of induction is probably not desirable in cases of this kind.

A patent issued in the year 1889 to a Mr. Dahl, tells us of another quite unique form of thermo-meter, and this is probably the only heat meter actuated by an actual field and armature arrangement. In this instrument, the inventor provides a field of iron excited by a few series turns on the lamp circuit. The strength of the field should therefore bear a more or less definite relation to the amount of current passing through its turns. I will not comment upon how direct this relation would be. It will suffice to say that the introduction of iron in the construction of any meter of this character is probably detrimental to its accuracy to a quite marked degree. On a shaft in the meter which we are describing, is suspended a kind of armature consisting of a flat disc-like ring of iron, supported by a number of spokes and mounted as a wheel; in fact it is mounted on a quite ordinary shaft mechanism suspended in proper bearings. The iron portion of the wheel rotates between the poles of the electro-magnet, or at times permanent magnet, just described. We have, in fact, a disc armature rotating in such a manner as to pass between two poles of a more or less strong field. On the principle of the familiar thermo-magnetic motor, rotation is obtained in this meter by so placing coils of wire or other suitable material under certain portions of the disc and in series with the lamp circuit, that the disc is differentially heated at the proper point; thus, with the peculiar armature construction described, a thermo-magnetic action is set up, somewhat akin probably to the action of the thermo-pile. The portion of the disc heated, is attracted toward the field coils, and thus the disc being progressively heated and cooling rapidly owing to its thinness, continuous rotation is set up.

I might add here, at the risk of digressing from my subject, that there is probably no known indicating device from the Cardew voltmeter to the Sir Wm. Thomson balance which could not be so applied as to make a more or less accurate clock meter.

The last thermo-meter now under consideration is also a thermometer (a commentary perhaps on the English language). An ordinary thermometer of somewhat modified construction, is surrounded at the bulb by a coil of wire in series, or in shunt, with the circuit to be measured. It is apparent that the rise and fall of this thermometer will be *more or less* dependent upon the heat developed by the coil, and the heat again will be more or less dependent upon the current passing, but, of course, the temperature of the surrounding atmosphere must necessarily introduce serious error.

Now, it has been more than once suggested, though never patented, I believe, that a constant ray of light supplied, we will say by an electric lamp burning when the meter is in circuit, if thrown upon this thermometer could be made to photographically mark on rotating sensitized paper, actuated by clockwork at uniform speed, a line, or rather a solid block of light whose lower termination or line of demarkation would represent the height of mercury in the tube. Thus, we have a curve of registration which only needs to be integrated with a planimeter to determine the consumption, always supposing that the indicating device is correct. I have said, "only needs to be integrated." How desirable a meter would be in practical service whose record needs to be integrated, can best be left to the judgment of the station manager and the public.

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[1] See also, *Transactions*, A. I. E. E., vol. vi., p. 32.

[2] *Transactions* A. I. E. E., vol. v., p. 35.

THE NEW STANLEY TRANSFORMERS.

It is now nearly two years since the announcement was made that the manufacture of transformers had been begun by a company specially devoted to this branch and unconnected with any of the large companies manufacturing the other requisites to an alternating system. The inaugurators of this practice, the Stanley Electric Manufacturing Co., have since then followed consistently the course mapped out by them, devoting their attention almost exclusively to the perfection of the transformer. While their very first products were an advance upon anything that had been produced theretofore, experience has enabled them to still further improve their apparatus not only in the matter of electrical efficiency, but also in regard to its mechanical details.

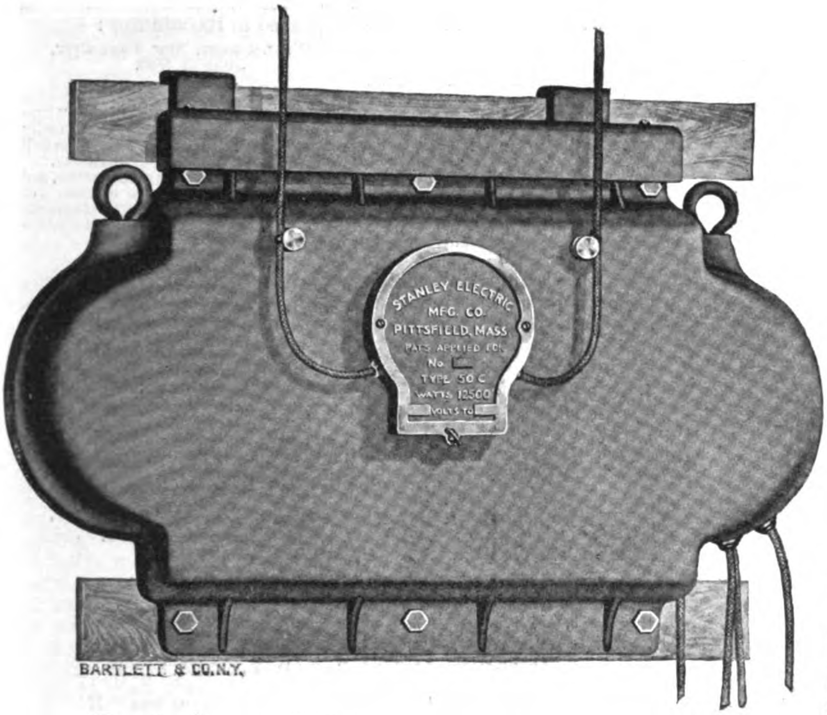


Fig. 1.—Stanley 250-Light Transformer. Out-Door Type.

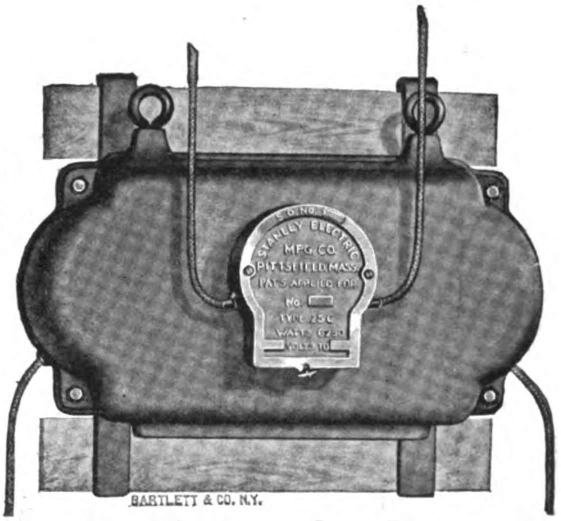


Fig. 2.—Stanley 125-Light Transformer.

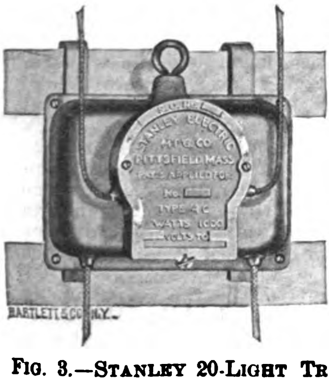


Fig. 3.—Stanley 20-Light Transformer.

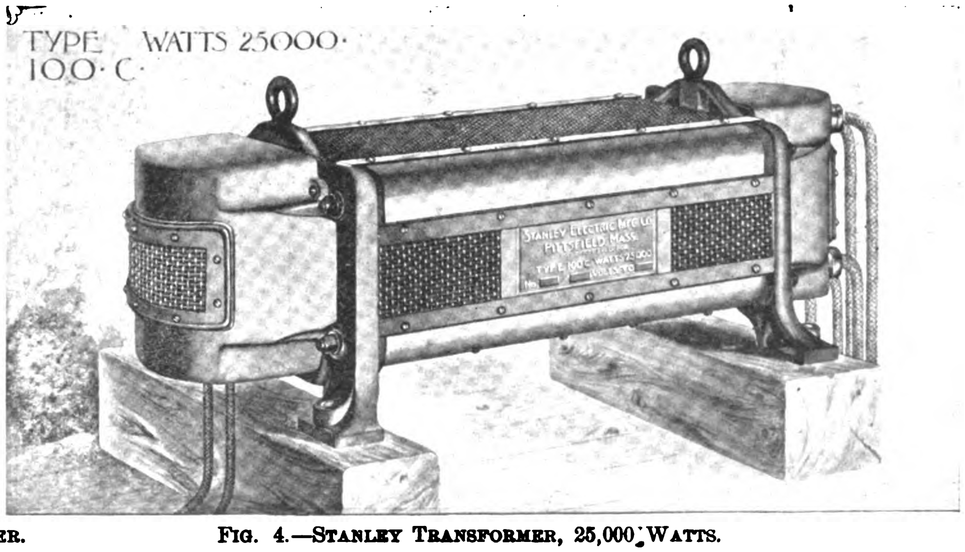


Fig. 4.—Stanley Transformer, 25,000 Watts.

Evidently the best designed transformer must eventually fail to do its work properly if its insulation fails, and as transformers are usually subjected to the full influence of the weather, their deterioration in this respect is far more liable to ensue than is the case in well housed apparatus which can be inspected daily. In these days of increasing use of higher potentials also, thorough insulation is more than ever a *sine qua non*. The Stanley Company have therefore devoted special attention to the insulation of their new type of transformers. The primary and secondary coils form a perfectly solid mass, and are protected from contact with the iron core by a new method. A cross section of a coil has the appearance of a first-class submarine cable, being absolutely moisture-proof.

The accompanying engravings, Figs. 1, 2, 3 and 4 show a few of the sizes of transformers of the new type. The efficiency of these is very high, as attested by recent tests made by Prof. Harris J. Ryan, of Cornell University, an account of which was given in our columns a short time since.

Their efficiency varies at full load from 97½ to 98, dependent on the size, while at quarter load they still show the remarkably high efficiency of 96 per cent. to 85 per cent. The regulation also has been so well kept in hand that there is only a difference of 1½ volts out of 50 at the terminals of the secondary between no load and full load.

In a recent catalogue, the company draw an apt analogy between magnetic leakage and regulation, and the efficiency and life of incandescent lamps; both being in their way inter-dependent of one another. In other words, in straining to decrease leakage, regulation is impaired, and vice versa. There is a medium point between the two, which is the best to aim at.

The Stanley Co. have from the first been advocates of the employment of large transformers wherever they can be properly employed, in preference to a number of smaller ones of equivalent capacity, and in conformity with this opinion, they are actually manufacturing a transformer with a capacity of 25,000 watts or equivalent to 500 lamps. The arguments in favor of the employment of large transformers are almost self-evident. Not only is their first cost of like lamp capacity smaller than for an equivalent number of smaller transformers, but the operating expense is vastly inferior. This becomes manifest when we stop to consider the loss due to leakage current in a large number of smaller transformers as compared with that of a single large one, Taking for example the case of one 250-light transformer. It has a leakage current of .2 ampere as against 9 small transformers of an equal capacity having a leakage current of .6 ampere. There would thus be an economy of 66⅔ per cent. in the energy consumed on no load; besides it must be evident, that with a small number of converters the cost of inspection and maintenance is much reduced.

The Stanley Co. has also devoted special attention to "boosters" or converters designed to transmit current to very long distances, where potentials up to and above 5,000 volts are required for economy. In this way, by converting at a station from 1,000 volts to 5,000 volts, and re-converting in the outlying towns or factories down again to 1,000 volts, a second central station is as it were established at the other end of the line. A number of such converters have already been stalled with eminent success by the Stanley Co

Particular attention has also been devoted to the minor details, though not less important, namely, the arrangement of the fuses. This is shown in engraving, Fig. 5. In accordance with the more modern practice only the primary circuit is fused. The fuse is double-pole, each wire or link being carried on a separate porcelain plug or block. To replace the fuse, the door is dropped down by simply loosening one thumb screw, the plug pulled out and an extra one inserted from the new fuse attached to the same plug. The same size of porcelain plug is used in all sizes of transformers, all plugs being interchangeable.

As no screw drivers or pliers are required, all danger from shocks by the line-man is avoided, as he is required to handle nothing but a highly insulated porcelain block.

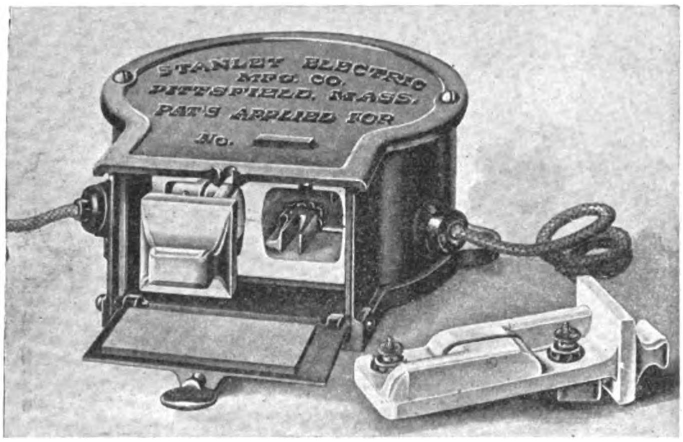


FIG. 5.—TRANSFORMER FUSE BOX.

The fuse-box inside of the iron is entirely of porcelain, thus making the whole fire-proof and the insulation perfect. The fuses are also entirely separated from each other by a porcelain partition, thus preventing arcing from one to the other.

Central station managers will, we are sure, find much to interest them in the new and highly artistic catalogue just issued by the Stanley Electric Manufacturing Company, of Pittsfield, Mass., from the press of E. E. Bartlett & Co.

ELECTRICAL ENGINEERING AT THE ARKANSAS STATE UNIVERSITY.

DURING the last year there has been established at the Arkansas State University a department of electrical engineering. The equipment as planned at present is designed to form the nucleus for further growth and enables the University to offer instruction in alternating and direct current, arc and incandescent systems, storage batteries, transmission of power and general experimental work.

The apparatus includes a 180-light Perret dynamo, two small Edison dynamos, a Westinghouse alternator, a six light Brush machine, a 10-h. p. Perret motor, a 3-h. p. Crocker-Wheeler motor and a few small machines built by the department. For experimental work there is available a 60-cell storage battery, Thomson balance and wattmeter, photometer, cradle dynamometer, Wheatstone bridge, Weston voltmeters and ammeters, magnetometers, Cardew voltmeter, eight galvanometers of various types, Wimshurst and Holtz machines, bank of incandescent lamps and large set of German silver resistance coils, so arranged as to carry dynamo currents, and to be free from the effects of self induction.

The course of instruction at the beginning of the junior year departs from that followed by the civil and mechanical engineers and offers work in the laboratory, in the elementary and more advanced theory of electricity, in electrical design, in specifications and contracts, and in the actual construction and operation of electrical machinery and apparatus.

The department is in charge of Prof. Harold B. Smith, a graduate of Cornell University, and associate member of the American Institute of Electrical Engineers.

INACCURATE REPRESENTATIONS OF THE WORLD'S FAIR ELECTRICAL FOUNTAINS.

WE have received the following important letter on the subject of the recent imaginative drawings that have appeared in one of our contemporaries, purporting to represent the World's Fair Electrical Fountains:—

To All who may be Interested:—

Reliable news regarding the progress of the plans for The World's Columbian Exposition is now of much importance to many electrical readers. The attempt of *The Electrical World* of this week to show in advance of the proper time of publication features which have not yet been decided upon regarding the proposed illuminated fountains, recalls a similar effort by the same paper less than three years ago.

At that time I sent to *The Electrical World* for publication the following letter, which never appeared in its columns:—

> 44 WALL STREET, NEW YORK CITY,
> June 25, 1890.
>
> Editor of THE ELECTRICAL WORLD.
>
> Dear Sir:—
>
> I am greatly interested in the sketch in your issue of this week of the "Proposed Edison Light Tower at the Minneapolis Exposition," more especially because, having the responsibility of designing and erecting this tower, I am still undecided as to nearly all the detail which your sketch purports to illustrate.
>
> I congratulate you upon the vividness of the imagination of your artist, and only regret that his idea and my own should have happened to be entirely dissimilar, and that his picture of this feature of the coming Exposition fails entirely to give your readers an adequate conception of the magnitude and beauty of the proposed structure and its surroundings.
>
> Yours very truly,

Both these unreliable batches of information came from the same source, the artist whose name appears on the illustrations. In the case of the Minneapolis Tower the disclosure was simply imaginative and premature; in the present case of the Chicago Fountains it is both imaginative and inaccurate and also a breach of faith. I presume it will be characterized as "newspaper enterprise"—the sort of enterprise that when it cannot print a genuine interview, prints an imaginary one.

I believe it was the celebrated A. Ward who once said "i had rather no nothing at all than to no what aint so."

L. STIERINGER,
Consulting Electrical Engineer,
World's Fair Chicago.

CHICAGO, Jan. 20, 1893.

LETTERS TO THE EDITOR.

IS STEINMETZ OR FARADAY RIGHT?

IN your issue of Jan. 11th I notice an article on the "Rotation of the Magnetic Field," by Mr. Chas. Steinmetz. This article is evidently intended as an answer to my criticism (p. 391 Vol. xiv) of his article (p 310 Vol. xiv) on "Twisting Magnetism." Mr. Steinmetz might have stated this fact without any fear of offending me, but as he did not, I have here done it for him.

Mr. Steinmetz states that "as long as the two characteristic quantities of the magnetic field, the intensity and the direction of the magnetic force, are constant in any point of space, the magnetic field must be said to be stationary and constant at this point of space." It is scarcely accurate to speak of direction as a quantity, but as the meaning of the sentence is clear and as I do not wish to be hypercritical I will let that pass.

I scarcely think, that Mr. Steinmetz meant what he wrote, as the words quoted are equivalent to saying that a uniform field of force must be fixed in space. For instance, assume a tangent galvanometer producing a magnetic field of sensible uniformity over a considerable space. Now suppose a small ring hung with its plane normal to the lines of force, from some fixed support outside the galvanometer. Next move the galvanometer in the plane of the ring, but not enough to bring the ring outside the uniform field. As the ring still encloses the same number of lines of force there has of course been no current or even E. M. F. induced in the ring.

According to Mr. Steinmetz the field of the galvanometer has not been moved; according to everyone else it has. But disregarding as he does, what everyone else says, I think that even Mr. Steinmetz will admit that when he carries a permanent magnet around in his pocket he also carries the field with it, whether the latter is uniform or not. If he does not he utterly deprives the term "field of force" of any intelligible meaning whatever. As the earth rotates upon its axis the imaginary lines called meridians rotate with it. We do not find the meridian of Greenwich for instance later in the day passing through New York and so on by the way of San Francisco and the Pacific Ocean back to Greenwich.

In the same sense in which the geographical meridians rotate with the earth, so do the magnetic meridians (neglecting the small diurnal variation); and so do the lines of force of every magnet, if the term "magnetic line of force" has as much meaning as the term "mathematical line."

TOWNSEND WOLCOTT.

NEW YORK, Jan 13, 1893.

LEGAL NOTES.

INCANDESCENT LAMP LITIGATION—HENRY GOEBEL, A NEW CLAIMANT FOR PRIORITY.

By Long Distance Telephone.

Boston, Jan. 23.—The columns of The Electrical Engineer last week contained a full and exclusive report of the interesting proceedings in Boston in the action brought before Judge Colt in the United States Circuit Court, by the General Electric Company against the Beacon Vacuum Pump and Electrical Company for alleged infringement of the Edison incandescent lamp patent. At that hearing, Monday, January 16, Mr. Witter, for the defence, obtained a delay of one week, in order that he might prepare and lay before the Court new evidence and an entirely new line of defence against any such action. The Court declined to enforce any sort of restraint against the defendant.

Pursuant to the adjournment for one week, until Monday, January 23, granted by Judge Colt, the case came up again for hearing to-day at 11 a. m. when Messrs. Witter and Brandeis again appeared for the defence, and Messrs. F. P. Fish, R. N. Dyer and C. A. Seward for the plaintiff. There were also in Court Mr. C. A. Terry, for the Westinghouse Electric and Manufacturing Company, with Messrs. Paul Cravath and Leonard Curtis; while Prof. Elihu Thomson and Mr. John Howell were in attendance on behalf of the General Electric Company.

Upon the opening of the Court, the plaintiffs asked for an adjournment of one hour in order that it might have time to examine a number of affidavits offered by the defence as the reason why no injunction of any kind should be issued against the Beacon Company. This adjournment was granted, and a recess was taken until 12 noon.

There were 28 affidavits, the more important of which ran as follows:

The affidavit of Heinrich or Henry Goebel, states that he is 74 years of age; was born in Germany, where he learned the trade of watchmaker and optician; was there thrown into association with one Prof. Moenighausen, a learned and ingenious man, for whom he made and repaired physical instruments; that this gentleman often talked with him about the possibility of making an electric light by means of a carbon conductor placed in a vacuum and heated to incandescence by the passage of a current. In 1848 he came to New York, and for more than 20 years carried on his business in Monroe street; in the early fifties he attempted to carry out some of the ideas of Prof. Moenighausen; he made a number of lamps of glass tubing having filaments of carbonized bamboo, and also of tampico; these were attached to wires of platinum, iron or copper, sealed air-tight into the tube by fusion; the air was exhausted by means of mercury and the lamp then hermetically sealed by fusion. From as early as 1855 to after 1881, he frequently made such lamps, and always had a number of them in his possession; often lighted his shop with them, with the aid of a battery of about 30 zinc-carbon cells; in 1859 and 1860 he was accustomed to exhibit in various public places in New York city, a large telescope mounted on a truck, through which he permitted people to look for a small fee; on this truck he had also a large battery and two or three of his incandescent lamps, which he was accustomed to light up to attract the attention of the passers by; these lamps were seen by a large number of persons, who well remember them. Some of these lamps have been preserved and accompany the affidavit.

The affidavit of John C. Goebel states that he is the eldest son of Henry Goebel and is an engineer; learned the machinist's trade from his father; remembers distinctly the electric lamps his father used to make in large quantities; often tended and lighted them himself; has a distinct recollection of having once looked at a picture in an illustrated newspaper of the shooting of Key by Sickles by the light of some of these lamps which stood on the show case in his father's shop (this event occurred Feb. 27, 1859); recognizes lamps shown him as exactly like his father's lamps; some of them had burners shaped like a fiddle-bow; others like a hair-pin and still others formed in a spiral; all were as small in cross section as the carbons of the lamps shown; remembers seeing his father make the spiral carbon by winding a very thin piece of wood around a cylinder, packing it in a crucible and putting the crucible in the fire. He remembers trouble his father had with employés of the gas company, who, seeing the electric lamps burning in the shop, accused him of having made a surreptitious connection with the gas mains. The light-giving portion of the lamps was always made of carbon, which his father called "coke;" the carbonizing was done in a range in the basement; he particularly remembers the use of a black lead crucible for this operation, because he used to wonder why, being lead, it did not melt in the fire; the wires passing through the glass were generally of platinum; sometimes of other metals; he bought little clippings and chips of platinum for this purpose because of their cheapness; does not remember how the air was removed from the lamps; does remember, however, that his father said there was no air in the lamps, and could not then understand how there could be space without air in it. He remembered his father's large telescope; sometimes exhibited it himself; there were at least three such lamps on the telescope wagon; had a great deal of trouble from slopping over of the batteries; one lamp, perhaps two, would burn while the wagon was going from Monroe street to Union Square; some of the lamps were destroyed as soon as the current was sent through them, but most of them were used repeatedly without apparent injury.

Henry Goebel, Jr., states that he is a son of Henry Goebel; has read his affidavit, and knows the electric lamps referred to therein; remembers seeing his father work upon and burn each of the three kinds of lamps mentioned by him, particularly the "hairpin" and "meat-saw" lamps. He frequently saw the lamps burning on the counter in his father's store, from his earliest remembrance; everybody could see them, and they attracted general attention. When a young boy he accompanied his father when exhibiting his large telescope in Union Square and other places, and remembers on a number of occasions hairpin and meat-saw lamps were burned just behind the driver's seat, partly to give light and partly to attract attention of passers by. Recognizes lamps shown him as some of those made by his father prior to 1872; the lamps did not burn long at a time because the batteries ran out; sometimes they would run half an hour or longer; many hundreds of persons must have seen the lamps burning on the wagon. Remembers his father thrashed him for breaking a meat-saw lamp the day he went to see his brother off who had enlisted in the navy during the war of the rebellion. All the lamps made by his father had the enclosing tube entirely of glass; the wires passed directly through the glass and had no solder or metal connection with the glass; the glass was fused directly round them and was fastened to the ends of two wires or ribbons, generally by stove-blacking. His father had a repeating clock fixed so that the mechanism would connect the circuit and light one of these lamps and illuminate the dial while the clock was striking; this was before and after 1872. In 1878 or '9 his father made a mercury vacuum pump which he used in exhausting lamps; he cannot remember any time prior to 1880, so long as six months at a time, when his father did not light up some of his lamps.

Horace E. Van Ranst, in his affidavit, states that he has been on the police force in New York for the past 32 years; knew Henry Goebel from about 1863 to 1872, when he was a watchmaker and optician; was frequently in his shop; he was a very sociable and interesting man, always experimenting and making something new. Remembers a large telescope that Goebel had mounted on a wagon, and behind the telescope on the wagon he had very brilliant lights which used to attract the attention of the crowd who followed the wagon; he also had some of these same lights in his store; remembers that the lighted part was enclosed in glass and that Goebel claimed that the light was produced by electricity, but does not recall having seen any batteries from which the electricity could come. Many people besides himself saw these lights; they were very remarkable lights and attracted a great deal of attention. Believes Mr. Goebel to be a man whose word could be thoroughly relied upon; he was a good-natured, reputable and reliable man, and was always experimenting; he once electroplated the buttons of his police uniform; he lived within two or three blocks of Goebel's shop.

Franklin L. Pope, makes affidavit that he is a solicitor of patents and expert; is familiar with the patents of Edison involved in the present litigation; has read the opinion of the Circuit Court of Appeals of October 4, 1892; understands the court to have held the then defendant to infringe the second claim of patent 223,898, that Edison's invention was practically made when he ascertained the hitherto unknown fact that carbon would withstand high temperature, even when very attenuated, if operated in a vacuum without the phenomenon of disintegration, and that Edison had utilized this fact by placing a filamentary carbon in a nearly perfect vacuum. The court had further said that no satisfactory evidence had been produced that the prior art had furnished any burners less than twice the size of that of the patent-office model of Edison's lamp. Deponent has examined the three exhibit lamps said to have been made by Goebel; neither of them is now in condition to be operated; but is entirely satisfied that when first made they were capable of such operation, and that they have at some time been so operated; each of these lamps originally consisted of a sealed chamber of glass within which was a carbon filament attached to metallic wires, which pass through and are sealed into the glass by fusion; the opening of the chamber has also been sealed by fusion; the light-giving portion of the filament in exhibit No. 3, is one and one-sixteenths inches long and from eight to ten one-thousandths of an inch thick; it is secured to the leading-in wires by indurated carbonaceous cement; the filament is made of carbonized woody fibre of endogenous growth, probably bamboo, the chamber is cracked and there is no vacuum in it now, but that there has been a vacuum in it is proved by the indentations at the top made by the pressure of the air when the glass was soft, and furthermore by the smoky discoloration on the inside of the glass which could only have been made by the vaporization of the carbon when in a state of incandescence. Deponent is clearly of the opinion that these structures embody the invention of the second claim of the patent in suit; moreover, the making and using of them necessarily involved a knowledge of the fact that a filamentary carbon would withstand high incandescence when placed in a nearly perfect vacuum. Referring to the affidavit of Goebel, in which he describes how he constructed his lamps, and how he obtained a supply of electricity for producing light, deponent is satisfied that it is entirely practicable to construct and operate such lamps with the methods and appliances which said Goebel states that he made use of, and that with equal care and skill in the manufacture that they would have a life commensurate with lamps made in accordance with the instructions laid down in the patent in suit. Some of the first lamps made by Edison lasted but a short time, but the long duration of some others demonstrated the correctness of the principle, and hence the question was how to make all the lamps last as long as the exceptional ones; this result has been secured by careful attention to all the details of manufacture.

PROF. CHARLES R. CROSS, of the Massachusetts Institute of Technology, makes an affidavit covering substantially the same ground as that of Mr. Pope, and confirming his opinions and deductions. He states that the cross-section of the carbonized filament of the Goebel lamp No. 3 was less than half that of the model accompanying the application for Edison's patent in suit.

NICHOLAS FINCK, in his affidavit, says he lives in Elizabeth, N. J., and keeps a jewelry store; is well acquainted with Goebel. Many years ago, about 1853, he made Goebel's acquaintance and was frequently in his store. Moved away from New York about 1855, and has since lived in Newark and Elizabeth. Has examined the exhibit lamps; has often seen such lamps in Goebel's possession and burning in his shop; can state positively that he saw such lamps before he left New York in 1855, and also since that time. Has frequently seen Goebel make the glass parts of these lamps; has seen him cut up the glass tubes and heat and work the glass; he used a bellows worked by the foot; there were two flames pointed towards each other with which he heated the glass. After the glass part was finished and the wires were in place inside, has seen him attach a long glass rod to the top of the lamp and fill the lamp and the rod with mercury and invert the lamp and let the mercury run out in a bowl; before the mercury had run out of the tube he would heat the tube near the top of the lamp and then twist it off so as to seal it tight; he said this was to get the air out of the lamp; asked him why he took the air out and he said that if any air was left in the lamp would be no good and wouldn't burn. He said the part which gave light was carbon and he made it; he showed him a crucible about six inches high in which he burnt the carbon. One evening saw him working with a piece of wood such as fishing-poles are made of, which he split up into pieces not thicker than fine wire or fine silk thread; saw a good many of these slivers before they were burned and afterwards; does not remember distinctly how the wires and the carbons were fastened together. Was concerned with Goebel in trying for eight or ten years to make something out of a patent for a hemmer which was granted in 1865, and this business led to his frequently seeing him at his place in New York; has no doubt from first to last, saw four or five different lamps before he left New York; sometimes they were used without any other light in the shop. Mr. Goebel was much discouraged by the constant trouble with the batteries. The shape of the carbons was sometimes straight and sometimes bent like a hairpin; the wires were attached to the ends of the hairpin. Mr. Goebel was a very ingenious man; made his own batteries, made his own tubes, carbonized the carbons and made the connections. Has no doubt Jacob Fey would remember the lamps; he was much about Goebel's store, and his statements may be relied on. Remembers taking his wife to Goebel's shop and showing her the lamps. Remembers the large telescope which Goebel used to exhibit at Union square, and that he had some of his lamps on the wagon that carried the telescope that were burned by batteries carried in the wagon; they were used to attract people to make use of the telescope.

JACOB FEY, of Brooklyn, makes affidavit that he is a native of Germany, a mason by trade, and came to New York in 1847; first knew Goebel in 1849; was often in his store in Monroe street; remembers well the little glass electric lamps which Goebel made and used; helped him make some of them; as many as fifty at least; Goebel used to heat the glass in a flame while deponent pressed the melted glass with pincers around the wires which went into the tube; would recognize the lamps if he saw them. Helped make some of them in 1852, and many more after he returned from Pennsylvania, which was in 1857. Has seen such lamps burning in Goebel's store hundreds of times; made a hole in Goebel's chimney before 1852 for him to put batteries in so that the fumes would go up the chimney. Helped Goebel to exhibit his big telescope once on Chatham square; has often seen the lamps burning on the wagon when the telescope was exhibited; identifies the lamps shown him as precisely like those he helped make; has seen Goebel take the air out of the lamps; he first filled them with quicksilver, then emptied them and sealed them by heating the glass; the lamps on the telescope wagon were to attract the attention of persons passing by and to induce them to look through the telescope.

GEORGE G. CROSBY makes affidavit that he was one of the organizers and general manager of the American Electric Light Company, formed about the beginning of 1881 for making and selling incandescent lamps; in March or April, 1881, learned that a man in New York named Goebel had an electric lamp and a vacuum pump, and was an expert in the manufacture of carbons and various physical instruments; sought him out and had a long conversation with him. Goebel showed deponent incandescent lamps which he said had been made a long time before, and that he had been making and using them constantly up to that time; he brought out a number of carbons, thirty or forty at least, which he had on hand; some of these were in the form of a loop; deponent took some of them home with him; they were from 2 to 3 inches long, thin and of very high resistance; they proved so much better than any the company had been able to make that they afterwards employed Goebel and his son to make carbons for them; but previous to thus employing him, he had made some lamps, glass and all, far superior to those the company had been making. Goebel had, when deponent first saw him, two vacuum pumps which he had made himself, and which were exceedingly good ones. Deponent at that time considered himself an expert in incandescent lamp matters, as in the early part of 1879 and until September, 1880, he had been employed in Edison's laboratory at Menlo Park, having while there worked under Edison's supervision upon carbons and vacuum apparatus. Deponent was impressed with and very much surprised at the knowledge possessed by Goebel, which was not only extensive, but surprisingly accurate. Deponent recognizes the lamps shown him as exactly like those shown him by Goebel at his first interview with him.

CELESTINE WEST, in her affidavit, says she is a daughter of Henry Goebel; recognizes the three lamps shown as precisely like those her father had as far back as she can remember, when he lived in Monroe street; has many times seen him make and use such lamps; most of them had straight carbons; some were hook-shaped but they were all thread-like, like the ones now shown her. Has often seen her father making lamps from glass tubing; remembers his carbonizing the thread-like part that gives the light, in a crucible in the fire. Does not remember seeing him extract the air from the lamps, but has heard him say there was no air in them. Remembers a lamp arranged to throw light on the face of a clock in his bedroom, which lighted up of itself whenever the clock struck. Remembers his large telescope on a wagon, and that he had some of the electric lamps on the wagon, but does not remember anything about the batteries; heard him speak about having them. Remembers having seen the lamps burning on the wagon a great many times as it started from the store, when going out in the evening for an exhibition.

MRS. NICHOLAS FINCK makes affidavit that she was married in 1858; that after her marriage and before the birth of her first child, which was in 1860, in company with her husband, she saw at Goebel's place several electric lamps; certainly more than two; they were lighted by electric batteries which her husband and Goebel explained to her; the lamps were little glass tubes, inside of which was a very slender piece which gave the light and which was connected by wires with the batteries; all the lamps were lighted; it was in the afternoon; never saw him make any of the lamps; never remembered seeing Goebel's lamps but that once, but has never seen incandescent lamps in recent years without recalling the fact that except the shape of the glass part they were just like the lamps in Goebel's shop. Remembers looking through Goebel's large telescope in Union square in the evening, and that the wagon was lighted; did not remember by what means. Is now shown for the first time the three exhibit lamps; they might be the very lamps she saw; can discover no difference in them. The light-giving part looked like a very fine wire white hot, and as she remembers it, not thicker than a thread. The light-giving part of lamps of to-day is in the form of a loop, but that of Goebel's lamps was straight; told Mr. Goebel it was a beautiful light and that he ought to get rich out of it; has never forgotten the effect which these lamps produced upon her mind.

A considerable number of affidavits were produced from old residents of that section of New York City where Goebel lived at the time he is alleged to have made and exhibited his telescope and his electric lamps. Most of these persons state that they have known Goebel from 30 to 40 years, that they frequently saw his lamps burning, both in his store and on his telescope wagon, and are able to describe them with considerable accuracy and to identify the exhibits. Many of them testify to his good character. The names of some of these witnesses are as follows:

John J. Benson, Alexander McArthur, James Benson, William Nethercott, William Whikehart, Thomas Conroy, James F. Conerty, William Harrigan (of Harrigan & Hart), John Galvin.

There were other affidavits also from Julia Zoller, E. Seger, E. Brush, G. Linder, W. Newman, T. F. Brady, H. J. Schwallenberg, and H. S. Kaliske, of the Beacon Co.

Upon the reassembling of the court, **MR. FISH** said they were ready to take the thing up now.

MR. DYER made a vigorous plea for an immediate injunction, pooh-poohing this mass of affidavits which had been presented showing a prior use in public of the carbon filament lamp 30 years back. He laid great emphasis on the improbability of the story amounting to anything, in view of the fact that it was claimed that the prior invention had been known to so many people in New York city. Had that been so it would have come out long before. Again, these affidavits set forth that Goebel, the claimant for priority, had been in the employ of the American Company in 1882. That old company was practically a part and parcel of the infringers against whom an injunction had already been secured, as it had become one with the Sawyer-Man, Consolidated, and Westinghouse interests. That being so, those defendants against whom they had already secured judgment must have known all about this thing, and yet they never produced it—which was significant. Mr. Dyer said they would be prepared to prove also that those defendants had been in possession of the Goebel matter for some months back, but had not found it desirable to try to use it.

Mr. Fish said that he would later in the day produce in court two affidavits, then being prepared, which would be offered in rebuttal of this mass of affidavits offered for the defence.

After the lunch recess, Mr. Dyer again made an urgent request for an immediate injunction, waiving aside as immaterial and as unworthy of further investigation this alleged prior use.

Mr. Witter, however, followed immediately in a long and able speech, which lasted about 1½ hours and was not concluded at the close of the day. He read long portions of the affidavit of Henry Goebel, the claimant for priority, and commented upon them very fully. This was the only affidavit taken up and discussed out of the twenty-eight presented before the Court and open for inspection. Mr. Witter urged the entire probability of Goebel's story.

The Court adjourned at 4.05 p. m. to reassemble at 10 a. m. on Tuesday.

G. M. P.

THE MANUFACTURE OF ALUMINUM.—DECISION IN FAVOR OF THE PITTSBURGH REDUCTION COMPANY.

The suit between the Pittsburgh Reduction Company, of Pittsburgh, Pa., and the Cowles Electric Smelting and Aluminum Company, of Lockport, N. Y. and Cleveland, Ohio, for infringement, was decided in favor of the plaintiffs, the Pittsburgh Reduction Company, on January 11, by Judges Ricks and Taft, of the U. S. Circuit Court for the Northern District of Ohio. The decision was a sweeping one, inasmuch as the Hall patent for the reduction of pure aluminum by electrolysis was sustained on every point. This gives the Pittsburgh Company a practical monopoly of the entire aluminum business of this country, as it is the only process used to-day in this country or abroad for the reduction of that metal. The suit has been going on for the last two years and the testimony covered 2,000 closely printed pages. The principal experts on the plaintiff's side were Prof. Charles F. Chandler, of Columbia College, N. Y.; Prof. John M. Langley, of the Case School of Applied Sciences, Cleveland, Ohio; Dr. Rossiter W. Raymond, expert metallurgist, and Secretary of the American Institute of Mining Engineers; and Mr. Charles M. Hall, the inventor of the process.

Mr. Hall, the inventor, is a very young man, being a graduate of the class of '84 in Oberlin University, where he conceived his process before his graduation. The invention consists in the reduction of the ore of aluminum, alumina, which is an oxide, by dissolving it in a fused mass of fluoride of aluminum, together with a fluoride of some other metal more electro-positive than aluminum, and precipitating the metallic aluminum from the dissolved alumina by means of electrolysis. The dissolving fluoride bath remains practically constant, and the process is a continuous one, for the reason that the ore is simply dumped into the bath, when the precipitation immediately begins, and the metal is either tapped out, or ladled out without interruption whatever. By it aluminum of exceptional purity has been brought from $12.00 a pound to 50 cents a pound, which, figured bulk for bulk, is as cheap as copper, and cheaper than tin or nickel. By the very careful estimates made by experts it is thought that by further refinements of this process aluminum can be produced on a scale of two or three tons a day at a cost of something like 17 cents a pound, which, bulk for bulk, is as cheap as zinc or lead.

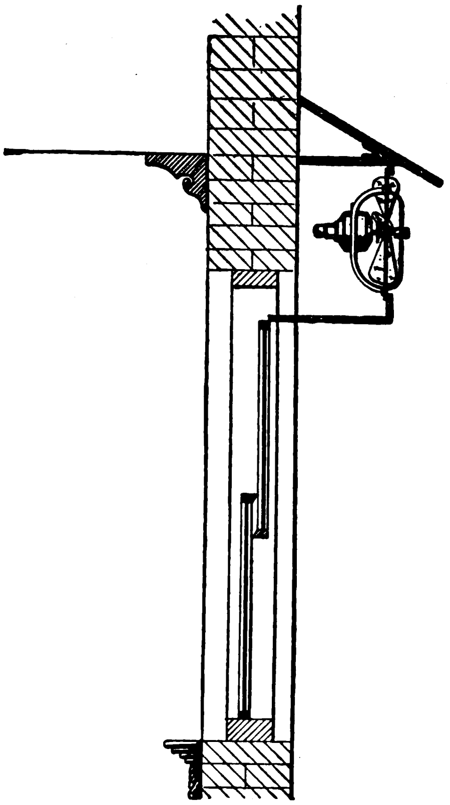
The attorneys for the plaintiffs in the case were George H. Christy and Thomas W. Bakewell, of Pittsburgh.

It may be added that in 1886, Hall had an interference suit with Heroult, who has large aluminum works, near Schaffhausen on the Rhine, Switzerland. The suit lasted a year and Hall was adjudged the prior inventor. The point at issue was one of those raised in the present suit and again decided in favor of Hall.

Pettingell-Andrews Co., the well known Boston electrical supply house, have been given the large and important New England agency for the Siemens & Halske Electric Co. of America. They will handle all the various classes of Siemens & Halske apparatus. The agency could not be in better hands.

VENTILATING A CLUB BILLIARD ROOM.

The present winter has put to a very severe test the ventilation of many rooms and halls which were supposed to be modern in every hygienic respect. When the cold is as rigorous as it has been the last month or two, the temptation to keep all the doors and windows closed can hardly be overcome. Heat units are doubly valuable, and the blast from the window or draughts from the door are so icy that nobody encounters them willingly. As a consequence, rooms remain either very chilly or seriously overheated; and this is true of many pretentious dwellings and handsome clubs and hotels. A study of this situation has led Mr. E. W. Little, of the Interior Conduit & Insulation Company, to hit upon a highly simple yet effective solution of the difficulty, and it is illustrated in this article. The special problem was the ventilation of the billiard room of the New York Clubhouse, on Fifth avenue. Mr. Little and other players there experienced annoyance as much, perhaps, from the heavy clouds of tobacco smoke as from the heat; and ordinary methods of "ventilating" only added to the discomfort. Mr. Little has therefore rigged up at an open window one of the Lundell globe motors attached to a small Blackman ventilating fan. The motor stands in a neat little box, with pent roof, just outside the slightly lowered window, and hence there is no interference with the window or sash proper. The motor is controlled by a switch in the room, and the sash itself can be raised or lowered at any time except that at which the fan happens to be running. A very little work of the fan will clear and purify the air, and yet there is no sudden indraught of cold air from any point; and the motor can be stopped whenever it has done its work.



Ventilating with Lundell Motor and Blackman Fan.

The success of this handy little outfit has suggested its application elsewhere, for summer and winter alike; and the Lundell motor, with ventilating fan is thus beginning to occupy a new field of usefulness. The motor and exhaust fan are supplied in various sizes, for the various currents, and with the due complement of starting and regulating boxes. The combination, and its method of application, are among the most ingenious things we have seen of late.

ELECTRIC RAILWAY GROWTH.

The General Electric Company reports the sale of one-fifth as many railway motors in one week in January as during the whole year of 1892. There are now 277 street railways in the United States, using an aggregate of 5,774 Thomson-Houston motor cars, and on January 15, 1892, there were only 180 street railways using 2,790 Thomson-Houston motor cars. This makes 2,984 Thomson-Houston motor cars sold from the street railway department, or an aggregate business of about $5,968,000 last year for motors alone.

IMPORTANT MEETING OF THE ADVISORY COUNCIL OF THE CHICAGO ELECTRICAL CONGRESS.

A MEETING of the Advisory Council of the Chicago World's Congress of Electricians was held at the rooms of the American Institute of Electrical Engineers, New York, on Jan. 17th.

The following gentlemen were present: Dr. Elisha Gray, Chairman, Prof. Wm. A. Anthony, Prof. Chas. R. Cross, Dr. Louis Duncan, Dr. Wm. Geyer, Mr. Carl Hering, Mr. Geo. A. Hamilton, Prof. F. B. Crocker, Mr. A. E. Kennelly, Mr. T. D. Lockwood, Mr. T. C. Martin, Mr. Geo. M. Phelps, Dr. M. I. Pupin, Mr. R. W. Pope, Prof. H. A. Rowland, Mr. Herbert Laws Webb.

Mr. H. L. Webb was elected Secretary of the meeting, in the absence of Prof. Carhart, permanent Secretary of the Council. The preliminary reports of the English and American Committees, already made public, were received.

It was resolved that the Electrical Congress of 1893 shall consist of two Chambers, of which the Legislative Chamber shall decide on units, names of units, and standards, and shall consist solely of delegates named by their respective Governments.

A Committee was appointed to determine the total number of official delegates and their apportionment to the various countries to be represented.

The following apportionment of delegates was made by the Committee whose report was adopted by the meeting. Great Britain 5, France 5, Germany 5, Austro-Hungary 5, United States 5, Belgium 3, Italy 3, Switzerland 3, Holland 2, Denmark 2, Norway and Sweden 2, Russia 2, Spain 2, Portugal 1, British North America 1, Australian Colonies 1, India 1, Japan 1, China 1, Mexico 1, Brazil 1, Chili 1, Peru 1, Argentine Republic 1; making a total of 55 official delegates.

It was resolved that a Committee on Invitations be appointed by the Chairman, this Committee to consist of 5 members who shall select and recommend to the Chairman the names of electricians, electrical engineers and others who shall be members of the Electrical Congress. Said Committee to co-operate with the foreign Committees.

It was further resolved that in addition to invitations to deliberating and voting members of the Congress, a general invitation shall be extended through the journals or otherwise that the meetings will open to the public, for attending the proceedings, but not for taking part therein.

It was resolved that a Committee on Programme and Papers be appointed by the Chairman. This Committee shall consist of eight members, whose duty it shall be to invite, receive and consider papers and other documents relating to the work to be done by the Congress. And it was further resolved that it shall be the duty of this Committee to formulate a programme for the Congress.

It was resolved that the reports of the English and American Sub-Committees which were received at the meeting should be referred to the Committee on Programme and Papers, and that the Committee confer with the English Committee as fully as possible and with such other foreign Committees as may be formed.

It was resolved that the Electrical Congress of 1893 shall last one week, beginning on August 21st.

It was resolved that a Committee of three be appointed by the Chairman as a Finance Committe.

It was resolved that an Executive Committe of five shall be appointed by the Chairman, said Committe to have full power to act for the Advisory Council.

It was resolved that the question of charging a fee for membership of the Congress, and fixing the amount of such fee be referred to the Executive Committee.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JANUARY 10, 1893.

Alarms and Signals :—

Railway Signal, W. F. Z. Desant, New York, 489,629. Filed Apr. 25, 1892.
An electrically operated semaphore.

Railway Signal, J. E. Geary, Syracuse, N. Y., 489,736. Filed Dec. 29, 1891.
An electric block system for steam railways.

Distribution :—

Electric Lighting System, F. B. Badt, Chicago, Ill., 489,598. Filed Oct. 22, 1892.
Employs a group of incandescent lamps, the filaments of which are connected in series, and conductors leading each from one main line conductor to a point in the series circuit between a pair of lamps.

Dynamos and Motors :—

Means for Controlling Electric Motors, J. F. Ott and A. E. Kennelly, Orange, N. J. 489,687. Filed May 7, 1891.
Provides means by which the motor can be controlled in a safe and efficient manner from either end of the car.

Variable Speed Electric Motor, C. Hering, Philadelphia, Pa., 489,709. Filed Apr. 30, 1892.
Claim 1 follows:
A duplex electric motor consisting of two electric motors both having the usual parts, namely, an armature and a field, one of which parts is fixed, two of which revolve and are mechanically coupled, and the fourth of which is capable of revolving and is connected to the work.

Galvanic and Thermo-Electric Batteries :—

Galvanic Battery, W. C. Cahall, Philadelphia, Pa., 489,522. Filed Sept. 29, 1891.
Employs a plate composed of the oxide of antimony intimately combined with carbon.

Galvanic Battery, G. L. Foote, Brooklyn, N. Y., 489.559. Filed Sept. 13, 1892.
Employs a rotatable zinc electrode with a stationary scraping device arranged below it.

Electric Battery, C. H. Bryan, Chicago, Ill., 489,668. Filed May 3, 1892.
A dry battery exciting compound comprising a mixture of salt of calcium, a ferrous salt and a salt of mercury.

Galvanic Battery, W. R. Reud, New York, 489,832. Filed June 23, 1892.
Claim 1 follows:
A galvanic battery of cylindrical shape having concentric poles and a ball secured to one end of the battery.

Lamps and Appurtenances :—

Electric Lighting System, H. M. Doubleday, Pittsburgh, Pa., 489,526. Filed Apr. 21, 1892.
Employs a reactive coil carried by the fixture or chandelier and two or more incandescent lamps with multiple point switch devices and circuit connections to different points in the length of the reactive coil.

Lamp Socket. A. Metzger, Schenectady, N. Y., 589,682. Filed Apr. 26, 1892.
A socket having an insulating body with an extension on which the terminals are mounted.

Socket Switch for Incandescent Electric Lamps, L. Henry and L. N. Dalysson, Newark, N. J., 489,739. Filed Oct 10, 1892
Provides means whereby the current may be turned on by pressing a button and turned off again by pressing the same button.

Hanger for Electric Lamps, C. S. Hume, Detroit, Mich., 489,815. Filed June 2, 1892.

Miscellaneous :—

Automatic Feed and Return Mechanism for Phonographs, M. O. Anthony, Cincinnati, O., 489,519. Filed Nov. 20, 1890.

Electrical Diaphragm, C. N. Waite, Newton, Mass., 489,551. Filed March 16, 1892.
A layer of acid resisting fibrous material and bi-chromatized gelatine.

Electric Gas Lighting Apparatus, A. M. Sloss, Kansas City, Mo., 489,616. Filed March 24, 1892.

Electrically Controlled Ventilator, S. G. Brinkman, New York, 489,625. Filed March 3, 1892.

Electric Gas Lighter, T. W. Lane, Boston, Mass, 489,653. Filed Jan. 25, 1892.

Bracket for Electric Light Wires, G. H. Bennett, Cincinnati, O., 489,861, Filed Nov. 16, 1891.

Electric Prison Cell and Guard, W. S. Hull, Sheffield, Ala., 489,902. Filed Sept. 22, 1891.

Railways and Appliances :—

Electric Railway Trolley, E. H. Jenkins, Winfield, Md 489,481. Filed July 20, 1892.
Invention consists of a longitudinally movable bracket evenly supported upon the end of the trolley pole and carrying the trolley wheel.

Electric Railway, D. E. Kimball, Topeka, Kans., 489,563. Filed Jan. 11, 1892.
Employs main and sectional conductors, a series of rock shafts, and switches between the conductors operated by the rock shafts, and a device carried by the car to close the switches when the car is passing.

Conductor System for Electric Railways, G. W. Von Siemens, Berlin, Germany, 489,573. Filed Feb. 3, 1891.
Employs a contact conductor composed of a series of relatively-insulated sections with normally-interrupted connections between it and the supply conductor; an electromagnetic device for each contact section and armatures adapted to be successively operated by a magnetic device on the vehicle, to close the circuit and complete the interrupted supply connections of the section into which the vehicle is moving.

Multiphase Railway System. F. B. Badt, Chicago, Ill., 489,597. Filed Feb. 19, 1892.
Claim 7 follows:
The combination of a movable car with means for leading from an insulated conductor a multiphase current thereto, a multiphase motor transformer on such car, a storage device to receive from such motor transformer and a switch to control connections from the insulated cable to the car, said switch responsive to a current delivered from such storage device.

Strain Insulator, Louis McCarthy, Boston, Mass., 489,658. Filed June 29, 1892.

Telephones and Apparatus :—

Spring Jack Switch, C. E. Scribner, Chicago, Ill., 489,570. Filed Dec. 27, 1880.
Employs a main lever and a yielding contact against which it normally presses, and a stop for limiting the movement of the contact toward the spring.

Spring Jack Switch for Telephone Exchanges, C. E. Scribner & W. R. Patterson, Chicago, Ill., 489,571. Filed Jan. 21, 1892.
Employs a pair of flat springs insulated from one another by a strip of rubber.

Attachment for Telephones, J. L. Davidson, Pittsburgh, Pa., 489,608. Filed Oct. 8, 1892.
A writing desk attachment for telephone wall sets.

Underground Electric Railway, J. B. Sheldon, D J. Murnane and G. L. Van-Beek, St. Louis, Mo., 489,764. Filed June 22, 1891.
Employs a main supply conductor, a pivoted switch provided with an exposed flexible contact, and consisting of a hermetically-sealed box with contacts located therein so arranged that when the switch is actuated the exposed contact is thrown into electrical connection with the supply conductor.

Closed Conduit Electric Railway, C. A. Stark, Duluth, Minn., 489,835. Filed Mar. 23, 1892.
Claim 1 follows:
An electric railway, comprising a surface conductor, a line wire held in a conduit adjacent to the surface conductor and adapted to connect therewith, a compressible rail, and means for closing the circuit through the surface conductor by the movement of the rail.

Electric Car Truck, T. Tripp, Avon, Mass., 489,883. Filed June 30, 1892.
Claim 4 follows:
In an electric vehicle, the combination of an axle, loose wheels adapted to rotate on said axle, an electric motor having two independently rotatable armature shafts disposed in endwise relation to each other, and connecting mechanism between said loose wheels and said shafts.

Switches and Cut-Outs :—

Electrical Switch, G. Baehr, Brooklyn, N. Y., 489,553. Filed Mar. 26, 1892.
A quick-acting double-blade snap switch.

Loop Switch, F. D'A. Gould, Schenectady, N. Y., 489,674. Filed April 15, 1892.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

GENERAL ELECTRIC PLANT IN THE INDIANA HOSPITAL FOR THE INSANE.

It is a rule to which we find but few exceptions, that when state and city governments undertake the construction and fitting up of establishments under their own immediate supervision, the work is excellently well done with material of the best, little expense being spared to make the job a credit. The electric installation by the Indiana state government in the Central Indiana Hospital for the Insane, at Indianapolis, is no exception to this rule. The establishment is one of unusual size, and the installation can be considered as one of the largest isolated plants in the country. The large building is divided into two separate departments, and the power and steam plants are both located in a small building 200 feet in the rear of the centre of the main buildings.

The generating plant consists of three 45 K. W. and two 25 K. W. compound wound General Electric Company's dynamos for direct incandescent lighting, and one 10 K. W. 30-light arc dynamo each directly connected to a high-speed engine of the Phœnix type drawing steam from three 125 h. p. boilers installed by the Phœnix Iron Works.

Three separate feeders of lead-covered cable, laid underground in water-tight boxes of 2-inch plank painted with insulating paint, run from the power-house to each main building. Each wire lies loosely in its place so that they can be drawn in or out at any time. Socket-bolted terminals are used where the underground cables connect to feeders in the basement and can be readily disconnected for testing purposes. Rubber-covered wires are carried from the feeders to the attic, and the current is fed from the attic down to the other floors.

The three feeders which run to the Women's Department supply three separate systems; feeder No. 1 furnishes current for 12 wards south from the grand centre of the building; feeder No. 2 supplies 11 wards north of the grand centre; feeder No. 3 supplies the grand centre itself, in which are the executive offices, and the rear centre comprising chapel, bakery, kitchen, etc. This last is an all-night circuit, controlled by a switch in the superintendent's office. A similar switch controls the all-night circuit in the sick ward, 600 feet north from the centre.

The wiring of an insane asylum differs materially from that of other institutions, not subjected to the peculiar conditions presented. In this case the wires are all run in moulding with backing, and the cabinet-cut-out boxes are set back in the brick walls. The covers are heavily-raised panels of extra strength so that they cannot be broken by the patients. Each cut-out box is furnished with a Yale lock, and each ward has its own cut-out box controlling from 20 to 65 lights.

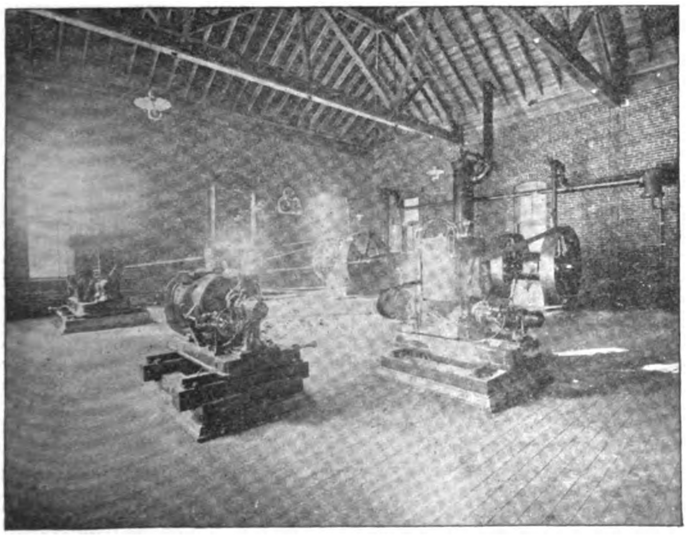


Fig. 1.—Dynamo Plant, Indiana Hospital for the Insane.

The 2,200 lights on the system are controlled by switches, and each switch, whatever its capacity, when operated controls an equal number of lights on each side of the neutral, with 110 volts only on each switch, so that overbalancing of the system is obviated.

All lights are thrown off at the power-house at 10 o'clock at night, with the exception of those in the sick wards and superintendent's quarters. A special switch changes the system from three-wire to two-wire at 10 o'clock, the smallest engine sufficing to operate the incandescent and arc dynamos after that time until morning. This switch is so connected that one, two or three dynamos can be thrown into multiple on the two wire system, together or separately.

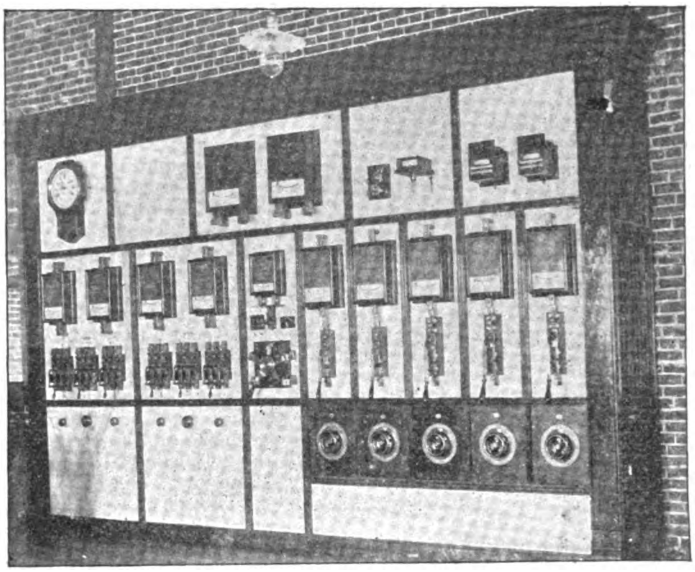


Fig. 2.—Switchboard, Indiana Hospital for the Insane.

There is 70 000 feet of moulding, from 1¼ inch to 5½ inch used on this installation. The lamps are suspended by flexible-cord pendants with key-sockets and porcelain cut-outs.

The arc circuit is used to illuminate the grounds. Two miles of General Electric lead-covered cable laid undergound in iron pipe, carries the current to the twenty 1,200 c. p. lamps suspended from 25-foot ornamental poles, well stepped.

The cable runs from lamp to lamp without splices. At the bases of each pole, and four inches below the surface is set a junction box 18 inches square.

The accompanying illustrations Figs. 1 and 2, show the dynamo-room and the switchboard respectively. The entire system is laid out with material of heavy enough capacity to carry 3,300 16 c. p. incandescent lamps, as well as the arc lamps. The installation was effected by the Chicago office of the General Electric Company and is pronounced by the trustees to be alike a "credit to the company and the state."

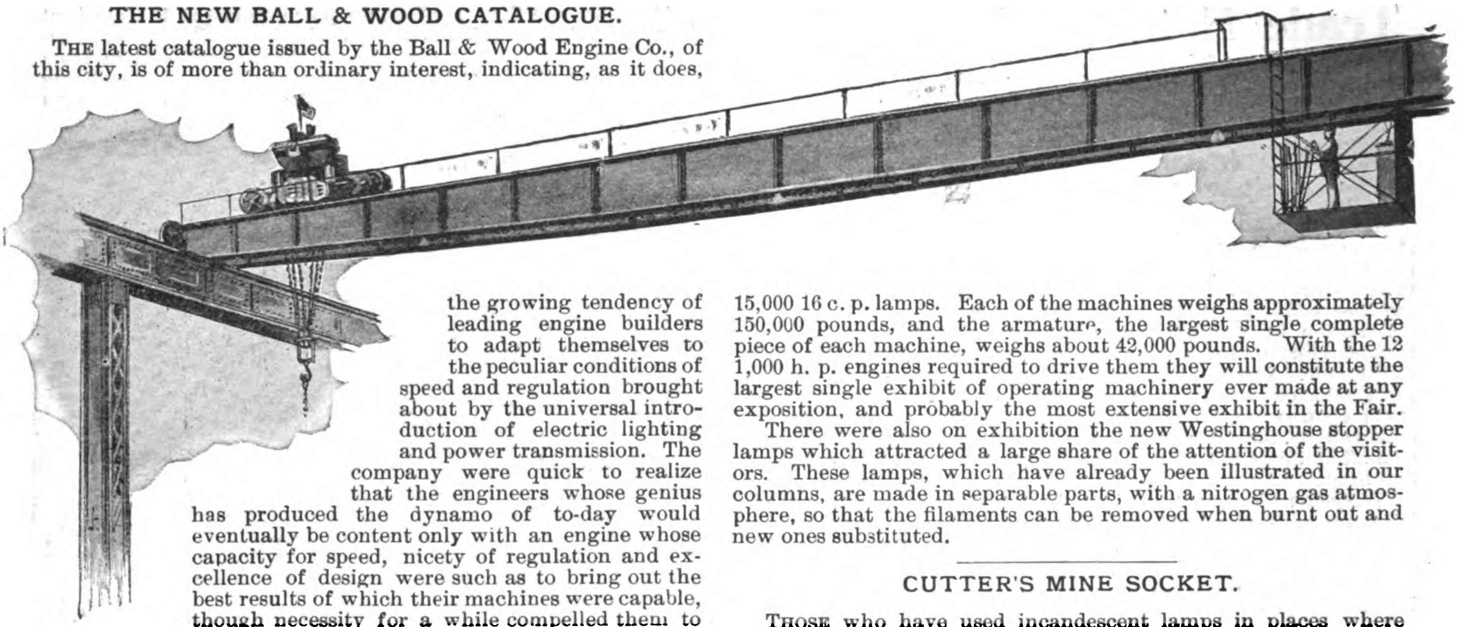
TERMINAL CHARGES AT THE FAIR.

The Traffic Department of the World's Fair has issued a memorandum to exhibitors and transportation companies containing the latest regulations concerning the charges for the reception and handling of exhibits on the exposition grounds. It is announced that the exposition will make a terminal charge of six cents per 100 pounds, with a minimum charge of 50 cents for any single shipment. Extra charges will be made for handling exhibits over 30,000 pounds in weight, and arrangements for the reception of such exhibits must be made in advance with the transportation manager. A charge of $5 per car will be made on all exhibits which arrive on their own wheels, such as palace cars to be exhibited in the Transportation Building, and $10 for locomotives arriving with their tenders. These charges will be made in each direction.

"WORTH FIVE TIMES ITS PRICE."

A reader in the South, electrician to a railroad company, writes us in renewing his subscription :—"Please let me say here that I would not be without The Electrical Engineer for five times the subscription price. Whenever I require anything (which is frequent) I can always tell where to send for it by looking over the advertising columns of The Engineer, and it has given me a vast amount of information. I say, long live The Electrical Engineer, and wish you every success."

THE NEW BALL & WOOD CATALOGUE.



THE latest catalogue issued by the Ball & Wood Engine Co., of this city, is of more than ordinary interest, indicating, as it does, the growing tendency of leading engine builders to adapt themselves to the peculiar conditions of speed and regulation brought about by the universal introduction of electric lighting and power transmission. The company were quick to realize that the engineers whose genius has produced the dynamo of to-day would eventually be content only with an engine whose capacity for speed, nicety of regulation and excellence of design were such as to bring out the best results of which their machines were capable, though necessity for a while compelled them to accept what was already at hand. Events have proved the accuracy of their foresight; to quote the language of the catalogue before us: "Perhaps there has never been witnessed a more striking instance of two mechanisms advancing hand in hand than this of the modern dynamo and the modern high speed engine."

It is of the merits of this engine, as designed by the Ball & Wood company, that the pamphlet treats. Simple, tandem and cross compound types, together with their separate parts in detail, form subjects for a set of illustrations that are masterpieces of the engraver's skill in this difficult class of work. The catalogue is further embellished with a number of artistic little wash drawings daintily executed and cleverly placed, and is bound in an embossed cover of electric blue bearing in relief the name of the company surrounded by a graceful design.

The catalogue is from the establishment of Messrs. E. E. Bartlett & Co., and is executed with all their customary artistic design and finish.

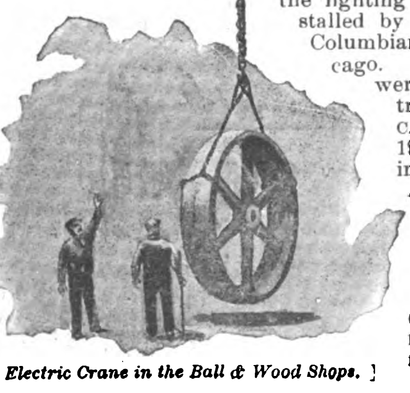
THE PERU, IND., ELECTRIC MANUFACTURING CO.

THE PERU GLASS AND CARBON COMPANY and Peru Porcelain Works (associated) have been succeeded by the Peru Electric Manufacturing Company, incorporated with capital stock of $100,000, and all accounts, both payable and receivable, have been assumed by the Peru Electric Manufacturing Company.

The new company have purchased the factories known as the "Dow Plant," regarded as one of the finest plants in the State and expect to occupy their new headquarters about the first of the coming year, when their products will be doubled, and with better accommodations more prompt service can be guaranteed. The officers of the new company are J. O. Cole, president; P. C. Burns, vice-president; S. F. Porter, treasurer and manager; R. H. Bologne, secretary; who are also directors with Milton Shirk, R. A. Edwards, and C. H. Brownell. The company will make, as before, but on a larger and more varied scale, carbons, carbon batteries, switches, sockets, rosettes, cut-outs, insulators and general electrical supplies.

THE WESTINGHOUSE WORLD'S FAIR EXHIBIT.

AT the invitation of The Westinghouse Electric and Manufacturing Company, a large number of visitors were afforded last week an opportunity of inspecting the lighting machinery to be installed by the company in the Columbian Exposition at Chicago. The dynamos which were described and illustrated in THE ELECTRICAL ENGINEER of Oct. 19, 1892, are now nearing completion in the Allegheny City Works of the Westinghouse Company, and are among the largest machines of their kind ever constructed. They are 12 in number, each with a maximum capacity of 15,000 16 c. p. lamps. Each of the machines weighs approximately 150,000 pounds, and the armature, the largest single complete piece of each machine, weighs about 42,000 pounds. With the 12 1,000 h. p. engines required to drive them they will constitute the largest single exhibit of operating machinery ever made at any exposition, and probably the most extensive exhibit in the Fair.

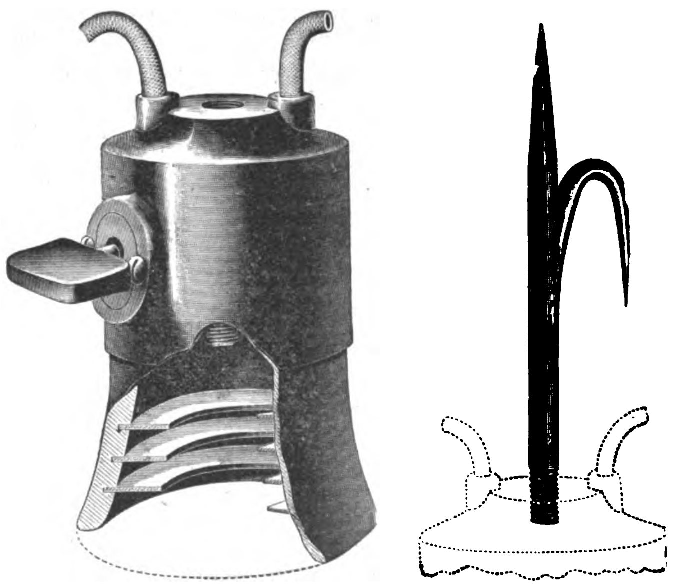


Electric Crane in the Ball & Wood Shops.

There were also on exhibition the new Westinghouse stopper lamps which attracted a large share of the attention of the visitors. These lamps, which have already been illustrated in our columns, are made in separable parts, with a nitrogen gas atmosphere, so that the filaments can be removed when burnt out and new ones substituted.

CUTTER'S MINE SOCKET.

THOSE who have used incandescent lamps in places where water is apt to run over them know how some so called waterproof sockets fall short of the mark. They apparently shield the works of the socket from the dripping water, but do not prevent the moisture from creeping up on the lamp and short-circuiting the cap. The result is that the fuses are blown much too often, thus leaving the men in darkness unless they have other lamps at hand.



CUTTER'S MINE SOCKET.

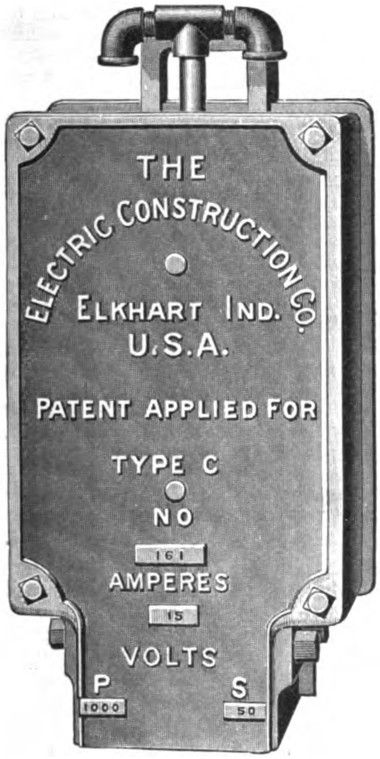
These defects in the ordinary rubber, glass or porcelain sockets have been considered by George Cutter, of Chicago, in developing the socket shown in the accompanying illustration. This has a well built interior (with porcelain insulations) protected by a casing of polished hard rubber. The leading in wires are cemented into the shell, while the handle or key passes through a bushing which is made watertight by soft rubber washers. These prevent any moisture from entering the shell at the sides so that the only danger is from the creeping of the water along the bulb of the lamp. To avoid this, the shell has a series of soft rubber rings which press against the bulb of the lamp when screwed into place and prevent any moisture from reaching the lamp base. It is said that such a socket can be used with safety in places where there is a steady dripping of water, and that it can be entirely immersed without any danger from short-circuits. When used in mines, it is furnished with a prong, as shown, so that it can be hooked in any convenient position.

THE SHULTZ BELTING CO., of St. Louis, have just taken an order from a Cleveland, O., concern for an 80 inch wide belt, which will be, it is said, the largest of its kind ever made in the world. It will be manufactured from Shultz patent sable raw hide.

THE ELKHART CONVERTER.

The Elkhart Converter which has been prominently set forth in our advertising columns for some time is being exploited in the West by the Electric Appliance Company, of Chicago, and is deserving of some special mention.

The general appearance of the apparatus is shown in the accompanying illustration. The case, as is customary, is an iron waterproof shell constructed with a view to the least possible weight consistent with the necessary strength.



The Elkhart Converter.

Its special feature however is, of course, its electrical construction. The coils are wound in an oblong coil extending the full length of the case, the secondary being first wound on a form and the primary wound over and upon the secondary. The iron is then built up inside and around the coils, the laminations being arranged in such a way that the joints are broken or staggered in every layer; *i. e.*, the joints do not come in the same place in any adjacent laminations. The result thus attained is that the coils are surrounded entirely by iron, making the converter almost a solid mass of iron, but at the same time broken up in a way that effectively prevents hysteresis, heating and magnetic loss. The converters are placed in neat, iron weatherproof cases ready to install as shown in the cut. The arrangement for fuses is of special construction, being a porcelain block with removable fuse cap, thus allowing fuses to be replaced with perfect safety.

SALES OF SIEMENS & HALSKE APPARATUS.

Mr. J. Holt Gates, General Sales Agent of the Siemens & Halske Electric Company of America, reports the following sales of electrical apparatus to January 1, 1893:

Pabst Heat, Light and Power Company, Milwaukee, two direct coupled multipolars of 250 h. p. each, speed 214 R. P. M., also one of 100 h. p., speed 277. Auditorium Hotel, Chicago, two 450's, speed 158; two of 300 h. p., speed 214; two of 150 h. p., speed 227. Broadway Power House, New York, two of 80 K. W. capacity, speed 235; one of 40 K. W., speed 300. Betz Building, Philadelphia, two of 80 K. W., speed 250; one of 40 K. W., speed 290. New Era Building, Chicago, two of 90 h. p., speed 360. Bauerle & Stark, Chicago, one 50 h. p. Co-operative Electric Light and Power Company, Chicago, two direct coupled alternating dynamos 600 h. p. each, speed 100 revolutions each. Buffalo Bill's Wild West Show, three of 100 h. p. each. Flint & Pere Marquette Railroad Company, two of 75 h. p. each. Filer & Stowell Co., Milwaukee, one of 75 h. p.

Messrs. Siemens & Halske have also obtained a large contract for the installation of two 1000 h. p. dynamos in the World's Fair grounds. Besides the above mentioned contracts there have been a number of smaller machines of belted type sold, several being purchased by railroad depots, packing houses and breweries.

The factory in Chicago is now in operation and will shortly be in position to fill orders for all sorts of electrical apparatus on short time delivery. The company will make a specialty of the long distance transmission of power by multiphase currents, this system having been worked out by them in Europe to the smallest details.

The following District Agents have been appointed:—

Chas. D. Shain, General Eastern Agent, 136 Liberty street, New York City, with States of New York, Vermont, New Hampshire, Maine, Massachusetts, Connecticut, Rhode Island, New Jersey, Delaware, Pennsylvania, Maryland, West Virginia and Virginia.

Messrs. Markle & Harnish, Central States Agents, Perin Building, Cincinnati, O., with States of Michigan, Indiana, Ohio, Tennessee, Kentucky, N. and S. Carolina, Florida, Georgia, Alabama.

Wisconsin Electrical Construction Company, Milwaukee, with States of Wisconsin, Minnesota, North and South Dakota, and the Western Peninsula of Michigan.

Messrs. Littlefield & Meysenberg, Bank of Commerce Building, St. Louis, Mo., with States of Missouri, Kansas, Oklahoma, Indian Territory, Texas, Arkansas, Louisiana, Mississippi, and the strip of Kentucky and Tennessee due south of the boundary line between Illinois and Indiana.

The general offices are in the Monadnock Building, Chicago.

QUEEN & CO., INCORPORATED.

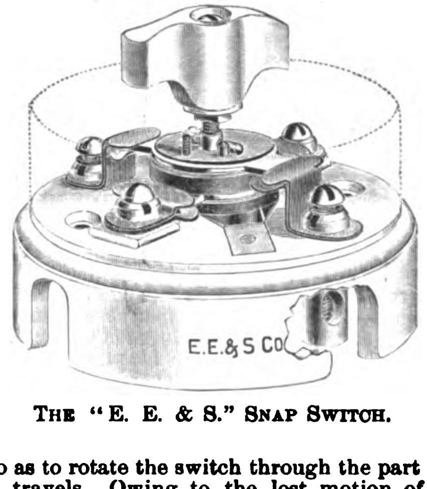
Queen & Co., incorporated, Philadelphia, are congratulating themselves upon the increasing demand for their "Magnetic Vane" ammeters and voltmeters as evidenced by the fact that more than twice as many of these instruments were sold by them in 1892 as in the preceding year. This advance is perhaps not astonishing when efficiency and cost of the apparatus are considered, but it shows a remarkable degree of appreciation on the part of purchasers.

The "M.-V." instruments are adapted for constant switchboard use, and voltmeters as well as ammeters can be left in circuit constantly, a feature of great importance to the central station manager. The makers are manufacturing in large quantities to supply demands which come from all over the United States. A number of prominent dynamo building companies have adopted the above type to install with isolated plants for incandescent lighting and for power circuits.

Descriptive circular No. 420 recently issued by Queen & Co. contains further information of value and will be mailed upon application.

THE "E. E. & S." SNAP SWITCH.

The accompanying illustration shows a 25 ampere, double pole, switch recently introduced and manufactured by the Electrical Engineering and Supply Company, of Syracuse, N. Y., and containing several novel and ingenious features. The contact is made by rotating metal arms mounted on a spindle and insulated from each other, so that they pass between two metal contact pieces mounted on each of the four binding posts and make a long wiping knife contact between the parts on both sides of the contact arms. In order to make and break instantly there are arranged in a recess in the porcelain base, two elliptical steel springs which press against the sides of a square frame-work holding a roller in each of its corners, so that in turning the handle the square frame-work is rotated until the rollers on two of the corners have compressed the two springs and are just passing the highest points when the contacts are about to be made or broken. Having passed this highest point, the springs press the rollers on the corners towards the centre so as to rotate the switch through the part of the circle in which it travels. Owing to the lost motion of the spindle there occurs instantly the make or break of the circuit with a sudden snap. The openings left in the side of the base facilitate surface wiring.



The "E. E. & S." Snap Switch.

This switch is said to have more carrying capacity than most switches designed for 25 amperes, and the wiping contacts constantly keeping the surface clean, the parts always run cool. The sudden break is of such length as to make the switch safe for use with currents of an electro-motive force of from 400 to 600 volts.

D'ODIARDI'S MEDICAL ELECTRICITY.

We have recently received from England a little pamphlet purporting to give a description of the electro-medical apparatus, etc., used by Professor D'Odiardi, of West Mall, Notting Hill Gate, and Cornwall Gardens, London, S. W. It is evident that in some branches of "medical" electricity, England is far ahead of America. We note that the pamphlet quotes Mr. Edison as saying that these instruments are "more effective and perfect than the apparatus hitherto employed;" and as admitting that he had only aided the distinguished professor "in a very modest way."

We cannot mention all the apparatus, but think that some of it will interest our readers, such, for example, as the lung healer in which "the vapor of extractum exoticum is loaded with static electricity at a high tension". Another amusing piece is the "electro-injector" which "can be employed with static or galvanic electricity. The current passes through a continuous liquid jet or is carried by separate drops according to the effects required. It cannot be replaced by any known instrument." But even this is a trifle compared with the "gaseous-high-electric tension current" (£50) which is "an apparatus for the simultaneous employment of magnetic lines of force, of static electricity and of voltaic and faradic currents on the bare body, immersed in various gases loaded with static electricity." But perhaps a patient might prefer the half-guinea diamagnetiser which is "employed with static electricity for softening of the brain" and other like diseases to which Professor D'Odiardi's clientèle seem peculiarly liable. The masterpiece of all is the "electro-spiral hood" (£500). This is as wonderful as it is costly. "The patient is kept alive in this apparatus until strength has been restored by nutrition. The wire of the coil is more than 300 miles long. The wind of the coil is 200,000." It appears that this will even make a dead man sit up and take his gruel, while an ordinary valetudinarian is soon rendered fit for a bout with Corbett.

And then there is the "deep plunge electrode" (2½ guineas) by means of which "the voltaic current is directed at will and may be made to plunge to any depth and in any direction without scattering or radiating." Or the "sleep-promoter," which "acts by itself," not only inviting to grateful slumber but regulating the bowels. This, like the "healing cup," (10 guineas, for private use only) is said to be a good substitute for chloroform, and rivals in benefit to mankind the 40 guinea "electro-inhaling cabinet," which is simply indispensable when the victim can afford to pay for it. Prof. D'Odiardi really ought to apply for space in the Electricity Building at the World's Fair.

AN ELECTRIC WHEEL OF CHICAGOAN DIMENSIONS.

The Detroit Bridge and Iron Works have secured the contract to build one of the biggest novelties to be seen at the World's Fair. Chicago and Pittsburgh capitalists will pay them $300,000 to construct what will be known as the Ferris wheel. It is to be constructed of iron and is 250 feet in diameter. It is to revolve on a shaft resting on two towers, each of which are to be over 125 feet high. On the circumference of the wheel is to be a series of cages arranged for the accommodation of passengers. When the wheel revolves the passenger is gradually raised from the ground to a height of 250 feet in the air. The wheel will be turned by electricity. There will be seating capacity for 2,150 persons.

The Utica Manufacturing and Supply Company are adding largely to their already long list of specialties. To quote from a circular recently issued by this company, their aim is not to furnish every-day cheap goods, but to manufacture and sell only the very best appliances, knowing from practical experience that every article used in the electrical business can not be made too good.

WESTERN NOTES.

The Central Electric Company have recently placed the Interior Conduit & Insulation Company's system of tubing and ducts in several of the largest buildings in Chicago, St. Louis and other western cities, the Newberry Library Building, the New Athletic Club, Congress Hall, and several other large buildings in Chicago being equipped throughout with this now essential system. The Lundell Motors, made up to 5 h. p., which have recently been put upon the market by the Interior Conduit & Insulation Company of New York, and are being introduced in the West by the Central Electric Company, are meeting with a ready sale, and the Central have already installed several of them in their territory. They have issued a complete descriptive circular and would be pleased to furnish them to any one desiring information bearing on the above.

Mr. P. W. Mitchell, of Doubleday, Mitchell & Co., 136 Liberty street, has been in Chicago booming the sale of their new quick break jaw switches. He reports business as very brisk.

The Electric Appliance Company will continue to represent the Emerson Electric Manufacturing Company of St. Louis as special Western selling agents for their celebrated Meston motor. The Electric Appliance Company handled this agency in a very satisfactory manner last summer, placing several hundred of the machines, the only difficulty being that the factory was unable to supply the heavy demand.

Preparations have been made this season however to anticipate any possible demand and a large number of machines have already been sold for May 1st delivery. It is rather cold business talking fan motors under the present atmospheric conditions, but the Electric Appliance Company have already booked a number of handsome orders and closed many of their sub-agency deals.

NEW ENGLAND NOTES

The Hawks Electric Company, has recently been organized under the laws of the State of Massachusetts, with a capital of $12,000, as successors to the business of H. C. Hawks, well and favorably known as a successful electrical engineer and contractor. The company have secured new and commodious quarters at 174 Summer street, Boston, and will carry on a general construction and supply business. Mr. Hawks, who has accepted the position of treasurer and manager of the company, has had a wide experience in the electrical business, having first started about eight years ago, with the Marr Construction Company of Pittsburgh, afterwards the North American Construction Company. Mr. Hawks has been in business for himself for the past two years, and has been exceptionally successful, and has now some fifteen important contracts in course of construction. Recently he has finished the construction of the North End Street Railway of Worcester, and has just closed a contract for 900 lights in one of the new factories of the Washburn and Moen Manufacturing Company, at Quinsigamund, near Worcester, Mass.

The Mather Electric Company, of Boston, have sent to a few of their friends a very beautiful calendar for 1893, which surpasses any before seen in the electrical business. It is a desk ornament, and contains a small calendar, a porcelain tablet for memoranda, and an actual clock "which goes" and keeps good time, the whole mounted on a handsome leather frame. All should send for one at once, as there is only a limited number.

Frank Ridlon and Company, of Boston, the well-known dealers in second-hand electrical apparatus, have at present for sale an extra large quantity of electric railway apparatus, sufficient to equip in every detail a road 100 miles in length. The apparatus includes generators, motors, wire and all overhead and necessary supplies. Street railway managers would do well to communicate with Mr. Ridlon before buying elsewhere.

Cumner, Craig and Company, of Boston, the young firm who have but recently gone into the electrical business, on their own account, have just been appointed exclusive New England agents for the Crocker-Wheeler Motor Company, of New York, and have already shown their business enterprise by sending in a number of orders for their well-known motors.

C. S. Knowles, of Boston, has recently opened branch stores at 143 Liberty street, New York, and at Room 109 Adams Express Building, Chicago, where he will keep large stocks of Tenax friction tape, splicing compound, Chatterton's compound, and other specialties which have achieved a wide reputation for unexcelled quality.

PHILADELPHIA NOTES.

Queen & Co., Incorporated, have sold nearly all the Ayrton & Perry ammeters and voltmeters, which they advertised so extensively at reduced prices, but a few still remain which are offered at a mere fraction of the original manufacturing cost; for instance, an ammeter with capacity of 400 amperes being placed at $16.00. Any one who wants a portable instrument for general testing, where great accuracy is not required, might find it very advantageous to purchase now, bef re the stock is entirely exhausted. Descriptive circular No. 355 will be mailed by the makers upon application.

Mr. Paul S. Reeves, of 760 South Broad street, Philadelphia, has enlarged the capacity of his plant last year to such an extent as to enable him to turn out 2,200,000 pounds of castings; an increase of 800,000 pounds over the output during 1891. He is making a specialty of castings for electrical work.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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WILLIAM WALLACE, AND HIS CONTRIBUTIONS TO THE ELECTRICAL INDUSTRIES.[1]—I.

BY

Wm. J. Hammer

I.

THE history of the development of the electric lighting industry in this country from its incipiency to this day, when it represents the gigantic capitalization of between four and five hundred millions of dollars, will, it is safe to say, never be recorded in a manner to do more than scant justice to the industry itself or to those who have the right to be termed its pioneers. Few, it is safe to say, of those connected with this important art to-day, can appreciate what that word "pioneer" really means, and none does so more fully than the author of this sketch. Any history of electric lighting, written or to be written, would indeed be incomplete without a reference to the early work in this industry of William Wallace, of Ansonia, Conn., and in view of the importance of his work in this and other branches of electrical science, and in view of the fact that text books and other scientific literature of to-day make little or no reference to what he has accomplished, it seems exceedingly appropriate that some recognition be made of his work, for Mr. Wallace represents the highest type of our American manufacturer, who, while occupied with the progress and development of important manufacturing industries, has still time, energy and capital to employ in scientific research and experimentation, in the development of a new art, and adding to the sum of human knowledge. To the writer, who has enjoyed an intimate and valued friendship with Mr. Wallace, extending over the past eleven years, it is a pleasure and privilege to present a record of some of his work which he has collected from various reliable sources, together with a short biographical sketch, which he feels sure will prove of interest to the readers of The Electrical Engineer.

William Wallace.

William Wallace whose portrait is presented herewith, was born in the City of Manchester, England, March 16th, 1825, and came to America with his parents, Thomas and Agnes Wallace, in 1832. Several years passed before the family settled upon a permanent location, but in 1841 they went to Birmingham, Conn., and the father and his three sons entered the employ of the Howe Pin Co. A few years later the father commenced the manufacture of brass and brass wire on his own account, forming in 1848, the firm of Wallace & Sons, consisting of himself and three boys.

Two years later they removed to the adjoining town of Ansonia, Conn., in order to take advantage of the water power supplied by the canal of Anson G. Phelps, which had recently been constructed. A single foot of water was estimated as giving sufficient power for their purposes, and it is interesting to observe from the appended cut of the works of Wallace & Sons, as they exist to-day, to what enormous proportions the concern has grown. It covers many acres of ground. Within a few months several new and extensive buildings have been added and the power required absorbs not only that of two engines of 1,000 h. p. each, but taxes the capacity of a dozen smaller engines scattered about the works. The concern employs over a thousand hands.

In 1853 the company was changed from a partnership to a corporation, retaining the firm name of Wallace & Sons, by which it is known to-day. Little or no electrical work is done to-day by the Company save in the manufacture of wire for electric lighting and power purposes, a specialty being feeder and trolley wire. The product of the factories embraces copper and brass goods in infinite variety, sheet brass and copper, brass, copper and German silver wire, copper rivets and brass metal chains, pins, cartridge cases, kerosene burners, lamps, and a great deal of other detail metal work.

II.

William Wallace, who is the second son of Thomas Wallace, deceased, is still living, hale and hearty, at the age of 67, and takes a very active interest in the Company, of which he is the President. He is a man of powerful physique, standing nearly six feet in height, and possessed of a boundless amount of energy and enthusiasm in his work, and a perfect genius for mechanical pursuits. Many of the special tools and machines in the factory have been devised by him, and he never seems so happy as when busy among his workmen at the mills, giving, as he has always done, his personal supervision to the mechanical affairs of this immense concern, mapping out the work, laying out new buildings, installing new engines, boilers and tools, and ever placing himself upon a plane with his men, who one and all hold him in the highest respect and affection.

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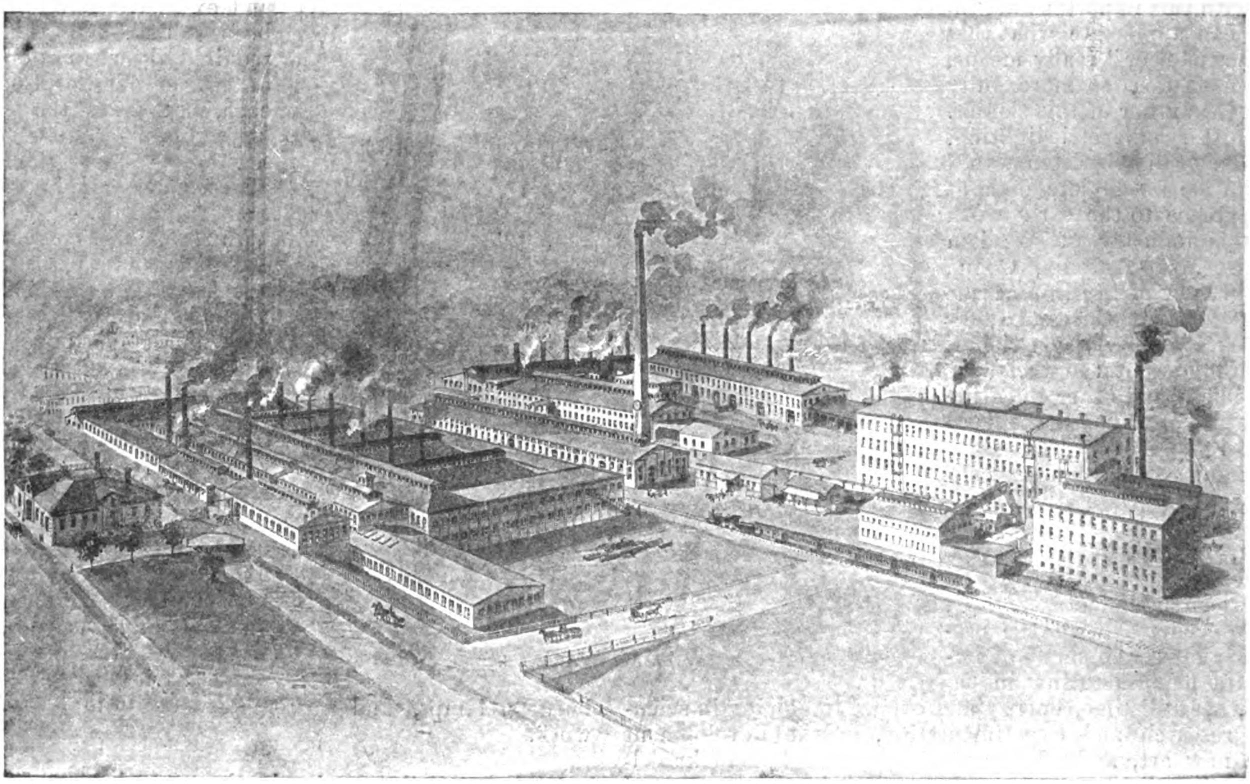
Mr. Edison's Goblet.



Bird's-Eye View of Wallace & Sons' Brass and Copper Rolling and Wire Mills at Ansonia, Conn.

The writer has frequently visited the Ansonia Works and watched with absorbing interest the powerful rolling machines and intricate pin and other machinery at work. One department he was informed had been visited by but four persons including himself, save by certain of the employees, since it was started. It contains apparatus which the company believed could be better protected by secrecy than by patents. A particular wire-drawing machine contained over $30,000 worth of diamonds and he was shown a store of onyx used in the lamp department representing a value of $25,000. It is stated that the company manufactures the largest amount of copper wire of any concern in the United States. The factory possesses the largest and tallest chimney stack in the state, rising to the height of 202½ feet from the ground, 16 feet square at the base and 7½ feet at the top. Sixty feet from the ground is the huge factory clock.

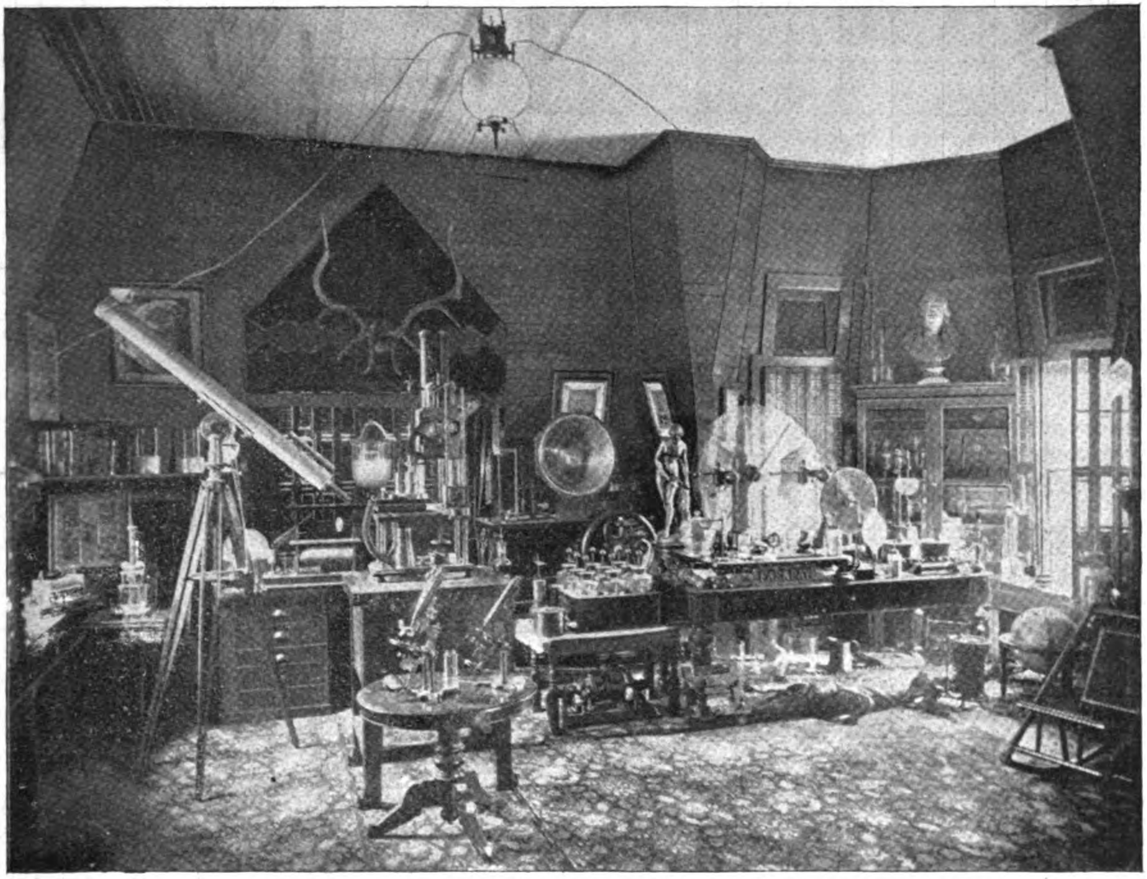
Adjoining the works of Wallace & Sons, stands the beautiful office building of the company, which is one of the handsomest equipped factory offices in the state, while a stone's throw from the office is situated the private residence of Mr. Wallace, which in the early days of electric lighting in this country was the "Mecca" towards which were directed the steps of many of the most prominent scientific men of the day as well as the steps of many of those who subsequently became prominently identified with the electric lighting industry. Among these may be mentioned Thomas A. Edison, who visited Mr. Wallace in the in the fall of 1878, in company with Dr. Henry Draper, Professor C. F. Chandler, Professor George F. Barker and Mr. Charles F. Batchelor, Mr. Edison's chief assistant. Here Mr. Edison witnessed Mr. Wallace's experiments in electric lighting, and secured from him a Wallace-Farmer dynamo, and a set of Wallace lamps for lighting his laboratory in Menlo Park, N. J. There is shown on this page a goblet which Mr. Wallace still has in his possession and which he treasures very highly, upon which Mr. Edison has inscribed in tiny lettery by means of a diamond the inscription "Thomas A. Edison, September 8, 1878, made under the electric light." The others in the party made similar inscriptions upon goblets, but with the exception of Mr. Edison's and one of Prof. Barker's they have all been, by some accident, destroyed. Before leaving Ansonia, Mr. Edison turned to Mr. Wallace and remarked, "Wallace, I believe I can beat you making electric light, I do not think you are working in the right direction." He then returned to Menlo Park, and shortly thereafter was caused the great excitement by his demonstrating to the public the subdivision of the electric light by the employment of the Edison incandescent lamp, filing his first patent for an incandescent lamp October 14, 1878.

Mr. Wallace has always endorsed Mr. Edison's claims as the inventor of the incandescent electric lamp, and so frequently has the writer thus heard him express himself, and so warmly has he praised the wonderful genius of Edison that the writer thought it would be interesting to learn the estimate Mr. Edison would give of Mr. Wallace and his work, and he sought an opportunity to question him. Mr. Edison spoke most kindly of Mr. Wallace, and among other things said: "Wallace is one of the earliest pioneers in electrical matters in this country. He has done a great deal of good work for which others have received the credit, and the work which he did in the early days of electric lighting others have benefitted largely by and he has been crowded to one side and forgotten."

Mr. Wallace's home, which has for many years been presided over by his daughter Eloise, contains may objects of great interest and value, and notwithstanding the busy life which he has led, he has frequently spent a portion of the year in travel about this country and Europe, and has gathered many of the treasures with which his home is filled. He has enjoyed a very wide acquaintance among the eminent scientific men both here and abroad, and they are always welcome guests at his home, where they are sure not only to meet with a hearty reception but find much to interest an entertain them.

III.

In the illustration herewith is shown a portion of Mr. Wallace's private laboratory, which is situated in the upper portion of his house. In this scientific den Mr. Wallace has spent many of his happiest hours, surrounded with his books and apparatus, and with gas, electricity, hot and cold water, and everything else at his command which is essential in a well equipped laboratory. A large screen is stretched across the entire end of one room, upon which Mr. Wallace projects by means of an electrical lantern which he has equipped, views, of which he possesses over three thousand, of various places of interest in different parts of the world which he has visited, and illustrations of various astronomical, microscopical, electrical and other scientific subjects; and frequently friends and neighbors gather in the laboratory in the evening to be edified by these displays and experiments which Mr. Wallace shows them in electricity and other matters.



WILLIAM WALLACE'S PRIVATE LABORATORY.

Mr. Wallace has kept aloof from all political entanglements in his town, and has steadily pursued his business and occupations; yet he has decided political opinions, is an ardent Republican and has ever been a friend of the veteran soldier.

In 1880 Mr. Wallace was taken seriously ill with pneumonia, and during the latter part of that year and early in 1881 he was forced to neglect his electrical and other work entirely. When he had sufficiently recovered to go on with his work he found his competitors in the electric lighting field had to a considerable extent forestalled him, and the duties of his position at the mills commanded so much of his time and attention that he was compelled to drop his aggressive work in the field which he had made so peculiarly his own; and it is not too much to say that had not his health broken down at this critical period, the name of Wallace would to-day stand at the forefront of those identified with the electric lighting industry.

During Mr. Wallace's serious illness in March, 1881, he was visited at his home by two of his intimate friends, men eminent in science, Prof. Henry Draper and Prof. George F. Barker. They had shipped to Ansonia in advance of them a mysterious box, the contents of which were unpacked and set up in Mr. Wallace's bedroom and proved to be a beautiful set of Prof. Crookes' vacuum tubes and apparatus for experiments on radiant matter, a gift from Prof. Draper to Mr. Wallace. The apparatus was exhibited to Mr. Wallace as he lay on his sick-bed and he says to-day that he believes this kindly act of theirs and the pleasure and benefit which he derived from the wonderful experiments which he witnessed, saved his life.

The writer recently asked Mr. Wallace what one thing in his past life of wonderful activity had left its greatest impress upon his mind, and after a moment's thought, he said, "The satisfaction that I felt in seeing work perfectly for the first time a mechanism which I had devised and over which I had been working for a very long period and which simplified very much certain processes in the mills."

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY.—XIV.

BY

A. E. Kennelly

STRESS DISTRIBUTIONS (CONTINUED).

THE stress distributions in magnetic circuits containing iron may next be examined, commencing with the simplest case. Let us take a closed circular solenoid of which the section S is so small relatively to the generating radii, that the intensity within it is practically uniform. This intensity will be $B = \frac{2Nc}{r}$. The total stress exerted along the flux paths will be $\frac{B^2}{8\pi} = \frac{N^2c^2}{2\pi r^2}$ and the total amount of this over the section S will be $\frac{SN^2c^2}{2\pi r^2}$. Suppose $r =$ 15 cms. $S = 2$ sq. cms., $N = 500$ turns, and $c = 0.5 = 5.0$

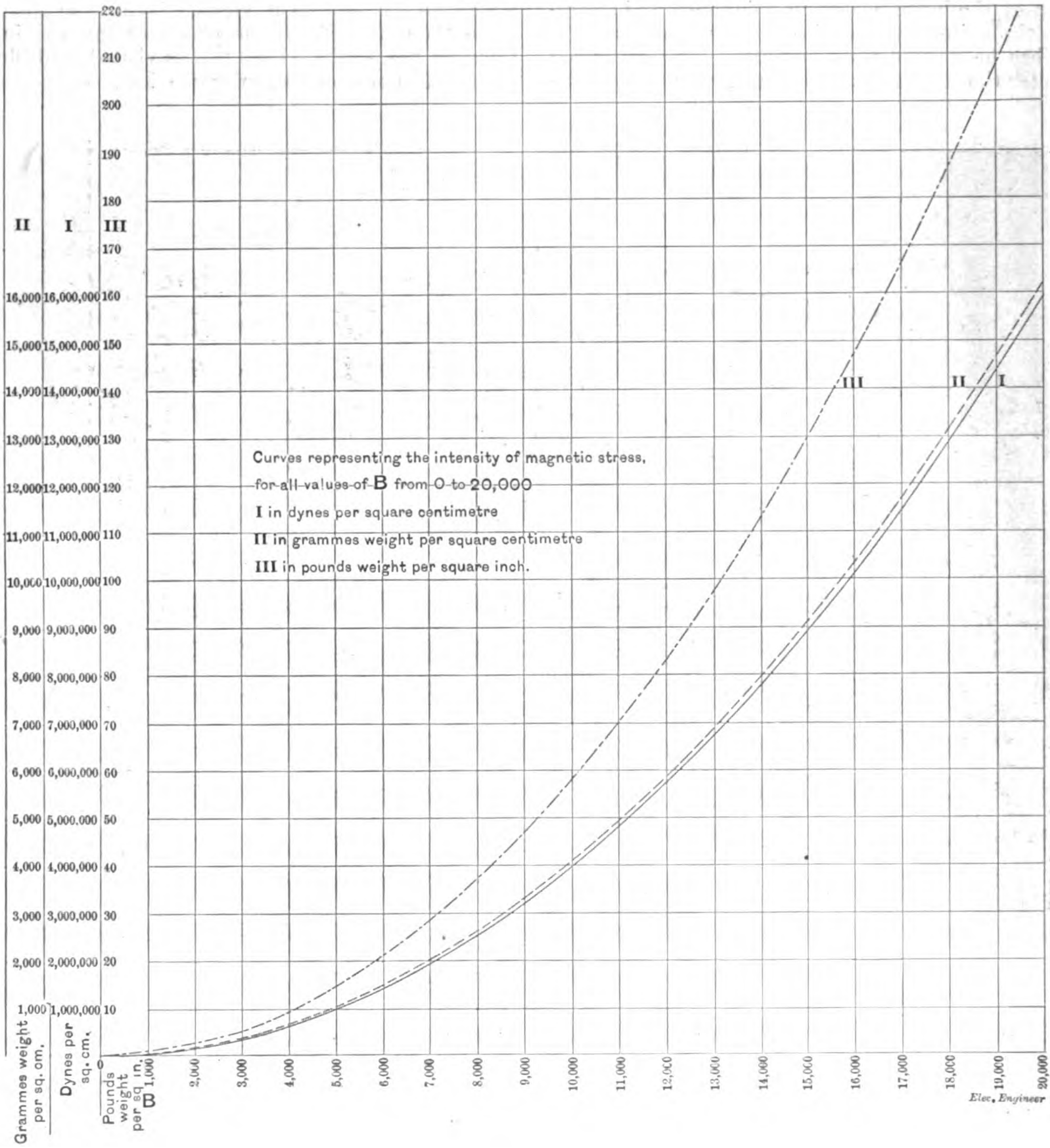


FIG. 34.

amperes; we have $B = \frac{2 \times 500 \times 0.5}{15} = 33.3$ C. G. S. lines per sq. cm. so that the total tension will be $\frac{2 \times 500^2 \times 0.5^2}{2 \times 3.14 \times 15^2}$ $= 88.4$ dynes, and this will be the stress exerted along the walls of the solenoid, across any radial section.

If now a soft iron core be inserted so as to fill the solenoid, the prime intensity of 33.3 will excite a total resultant intensity in the iron of $33.3\,\mu$ or perhaps 16,650 C. G. S. lines per sq. cm., since μ would be about 500 for this excitation. The stress for this intensity would be $\frac{(16,650)^2}{8\pi}$ or approximately 11,000,000 dynes per sq. cm., and the total stress, 22,000,000 dynes, will be supported by the iron core and the solenoid together. Since we may regard the core as magnetically equivalent to an independent internal solenoid of definite excitation, we know by the results reached in the preceding chapter, that the stress on the walls of the outer solenoid will be, so far as mechanical freedom will permit, equal to that sustained before the insertion of the inner solenoid, in this case the iron core. The coil in this case will therefore retain the stress of 88.4 dynes, and the remainder, or 21,999,911.6 dynes, will be supported by the iron core, assuming that coil and core are mechanically independent or frictionless. It is evident that in nearly all cases that can practically occur, the share of stress supported by the solenoid is relatively so small when it encloses iron, that the core may be regarded as exerting the entire stress.

If the ring were divided into halves by a plane through the axis of revolution, each section would support 22 megadynes, and the total attraction between the two halves would be 44 megadynes, or 44.85 kilogrammes weight. The introduction of the iron core has increased the power 250,000 times.

Fig. 34, gives the curves representing the value of $\frac{B^2}{8\pi}$ in dynes per sq. cm., grammes weight per sq. cm., and pounds weight per sq. inch, enabling the tension corresponding to any flux density to be determined by inspection. Thus, if two smooth plane surfaces of iron are brought into contact, and a uniform intensity of 14,000 passes perpendicularly across the plane of junction, the attraction between those surfaces will be 7.8 megadynes, or 8 kilogrammes per sq. cm., or 113 lbs. per sq. inch of contact surface. If the plates are not in contact, but lie parallel to and facing each other, their attraction will still be the same if the intensity remains unaltered in value or distribution. In practice, of course, this is not generally the case, and the intervention of an air-space between the plates will cause the flux to diminish and to deviate from the perpendicular in its passage.

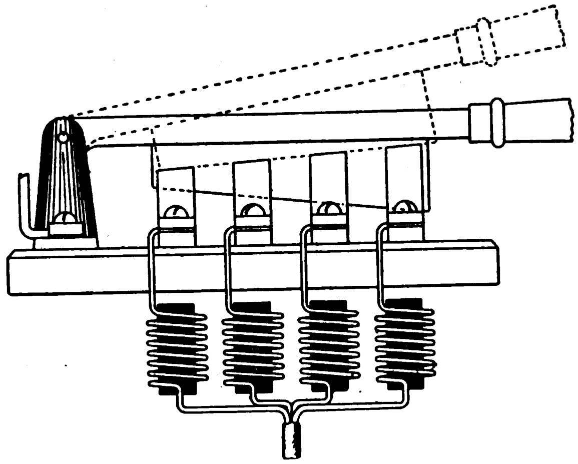
Suppose that the air gap between two parallel and similar opposed pole faces is d cms. across, the intensity at, and near, the polar edges, will be curved and variable from point to point, but at any point in the air gap between the poles not less than $\frac{d}{2}$ cms. from the polar edge the intensity B_d say, will be practically uniform, and perpendicular across, so that the stress, or attraction between the poles will be $\frac{B_d^2}{8\pi}$ dynes per sq. cm. of surface, and less than this near the edges.

The next case in order of complexity, is that of a closed circular solenoid in which, owing to the area of cross-section, the intensity may not be regarded as uniform. The prime intensity varies from $\frac{2Nc}{r}$ at the inner wall to $\frac{2Nc}{R}$ at the outer. With an iron core, the value of μ will generally differ at these limits, and the resultant intensities will tend to approach more closely than their excitations. The value of B will differ at different points in a section, not only on account of difference in the radius, but also owing to the variation in μ due to the different excitations thus established. We can no longer obtain the total stress from the product of $\frac{B^2}{8\pi}$ and the cross sectional area, but some process of average or summation must be resorted to, according to the degree of accuracy desired.

As a numerical instance, suppose $R=15$, and $r=10$, to be the outer and inner generating radii of the soft iron core whose breadth is $h=5$, and section square, $N=600$, and $c=3$ amperes, $=0.3$. Then the prime intensity at the inner wall is $\frac{2 \times 500 \times 0.3}{10} = 36$, and at the outer wall $\frac{2 \times 600 \times 0.3}{15}$ $= 24$. For $H = 36$, μ might be 400 in soft iron, and for $H = 24$, 500, so that the resultant intensity would range from $24 \times 500 = 12,000$ at the outside to $36 \times 400 = 14,400$ at the inside of the core, the corresponding stresses being 5.85 and 8.4 kilogrammes per sq. cm. respectively. As a first approximation to the total stress, we might take the mean value of these extreme limits or 7.125, and the area of cross section, 25 sq. cms., making a product of 178.1 kilogrammes weight. A closer result would be obtained by determining a series of prime intensities for intermediate radii, multiplying each by its corresponding μ, and then taking the average of the $\frac{B^2}{8\pi}$ values. Or an empirical relation could be assigned by trial between μ and B so that the total stress could be determined by integral calculus. The limit of accuracy would be ultimately determined by the precision with which the scale of μ could be experimentally determined.

THE THOMSON MULTIPLE CONTACT SWITCH.

The difficulty of constructing a multiple contact switch for heavy currents in such a manner that the break shall be absolutely simultaneous at all points is well-known. It is also evident that if the breaks are successive, though the intervals be exceedingly small, the current energy will be concentrated upon the last point of contact and tend to injure the switch.


THOMSON MULTIPLE CONTACT SWITCH.

To obviate this danger Professor Elihu Thomson places in circuit with each of the multiple contacts an induction coil so arranged that under ordinary circumstances no impedence is offered to the current flow, but which allow only the proper proportion of current to traverse each contact upon the opening of the switch. The increased current, tending to rush through the contact last broken, sets up a counter electromotive force that prevents its passage during the short interval between the last break and those preceding.

The accompanying illustration shows the device so clearly as to render further explanation superfluous.

LAMINATED OR DIVIDED IRON AND OTHER METALLIC MASSES IN ELECTROMAGNETIC APPARATUS.—V.

BY

Thos D Lockwood

Faraday.

Long after they were brought out in 1868 and 1873 the first and second editions of Ferguson's "Electricity" ranked high as textbooks. On page 187 of the latter edition, the advantages of iron wire cores are discussed with great intelligence, and enlarged upon; the wires must be insulated, which, however, is sufficiently effected by rust that gathers on them. If tubes are employed, they must be slit longitudinally.

In 1873 also, we arrive at the first distinct word concerning the dividing into discs of drum armature cores, appearing since Henry's note on Ettingshausen's proposal. It is to be found in a note by M. A. Pellerin, transcribed from *Comptes Rendus*, Vol. 77, p. 561, by *The Telegraphic Journal*, London, to the effect that to prevent heating arising in the Siemens bobbin from induction currents flowing in the mass of the metal core, and other causes, the core is to be built up of soft iron insulated discs.

In his *Exposè des Applications De L'Electricitè*, the Count Du Moncel, exercising his functions of chronicler, tells us (Vol. 1, p. 243) that "through Page's researches, we know that Sturgeon it was, who substituted bundles of iron wires or plates, discs of iron rolled spirally, or simply sheets of laminated plates as cores for induction coils."

The British patent of Edward H. C. Monckton, No. 3509, of Oct. 12, 1874, describes a variety of laminated and split electromagnetic cores, and also slit enclosing cylinders for electromagnets. To make a magnet core several rods or flat, thin sheets are combined instead of a single bar, and these may be electroplated, or thin sheets of copper or brass may be interposed between each two.

In the British patent, of Desmond Fitzgerald, No. 3807, of Nov. 2, 1875, is described an induction coil having a central soft iron core, and a surrounding cylinder of soft iron, both core and cylinder being longitudinally grooved or slit.

In 1876, we find a considerable amount of activity in the subject. In February of that year, Prof. John Trowbridge communicated a Memoir to the American Academy of Arts and Sciences, "On the effect of thin plates of iron used as armatures to electromagnets." This paper referred to a previous one presented April 13, 1875. Among other points mentioned which had been experimentally determined, was the following: That to produce longer sparks from an induction coil whose core was formed with a closed magnetic circuit, it was necessary to substitute for the "armatures" thin iron plates. This being done, a gain of about 400 per cent. was noticed. A still further slight gain was manifested when the armature plates were placed edgewise on the cores. Prof. Trowbridge's Memoir appears in the *Philosophical Magazine* (Vol. 1, N. S., 1876, p. 564), and in the *Journal of the Telegraph*, New York (Vol. 9, No. 13, July 1, 1876, p. 198). It is also noticed in the *Scientific American* (Vol. 34, N. S., No. 23, June 3, 1876, p. 356), and in the *Telegraphic Journal*, London (June 15, 1876, Vol. 4, p. 177).

In this year, also, Dr. Eduard Zetzsche published in *Dingler's Polytechnisches Journal* an account of the new Siemens machine, which was copied in the *Journal of the Telegraph*, New York (Vol. 9, No. 16, Aug. 15, 1876, p. 243), which states that when the armature core of the Siemens machine is constructed to revolve with the coils, it should, to avoid *Foucault currents*, be made of "coils of iron wire wound on a wooden cylinder." From this point forward, the division of iron in electromagnetic apparatus becomes so popular, and its mention in patents and publications so frequent, that its further classification by years is now undesirable, and the references to follow are therefore arranged in the several classes of United States and other patents, and then of publications.

THE NEW WESTINGHOUSE STOPPER LAMP.

In our last issue mention was made of the invitation extended by the Westinghouse Company to its friends to inspect the machinery to be exhibited by it at the World's Fair, and also to inspect the new stopper lamps, a large number of which are burning at the shops in Alleghany.

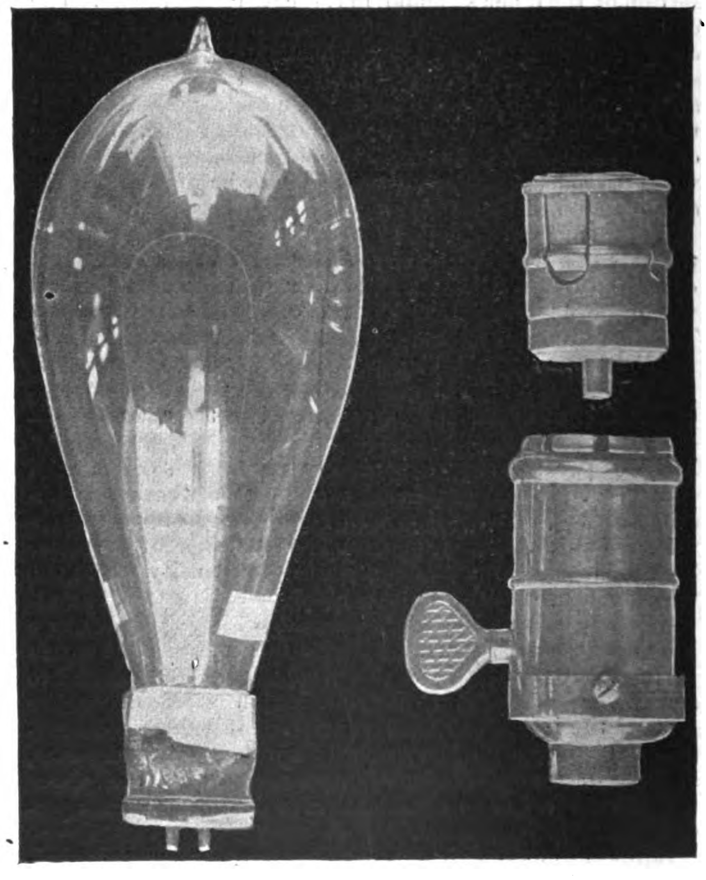


Fig. 1.—Westinghouse Stopper Lamp, Base and Socket.

(Photographed from Lamp.)

We have fully described the machinery and have also had occasion to refer to and describe the new lamp in our issue of Oct. 26, 1892, but we think our readers will be interested in some exact photographic reproductions which we give on this page and which, for the first time, show accurately all the details of the new lamp. Our engraving, Fig. 1, shows the lamp complete, separated from the removable Westinghouse base and socket; Fig. 2 shows the stopper removed from the lamp. It will be noted that the stopper, consisting of glass, has the leading-in wires passed through it for a distance of an inch and a quarter.

This length allows of a perfect seal being obtained. The leading-in wires are of iron, and a special glass is employed, the coefficient of expansion of which is practically the same as that of the iron; thus the use of platinum is avoided. The iron leading-in wires, it will be observed, are thickened at the bottom, making two stubs which are quite stiff, upon which the contacts in the base bear.

The stopper is ground in a special machine and fits into the corresponding neck in the bulb of the lamp. When the stopper is inserted, a cement is applied which aids to maintain a perfect seal. When it becomes necessary to renew the filament, the stopper is removed, a new filament is attached to the leading-in wires, the stopper is re-inserted, and the lamp is again exhausted. This operation can be accomplished at a very small cost, and hence there ought to be no excuse for the continued use of blackened lamps.

During the exhausting of the lamps, the Westinghouse Company introduce nitrogen gas at intervals, for the displacement of the oxygen of the air, so that the residual atmosphere, when exhaustion has been carried to the last point, consists largely, if not entirely, of nitrogen.

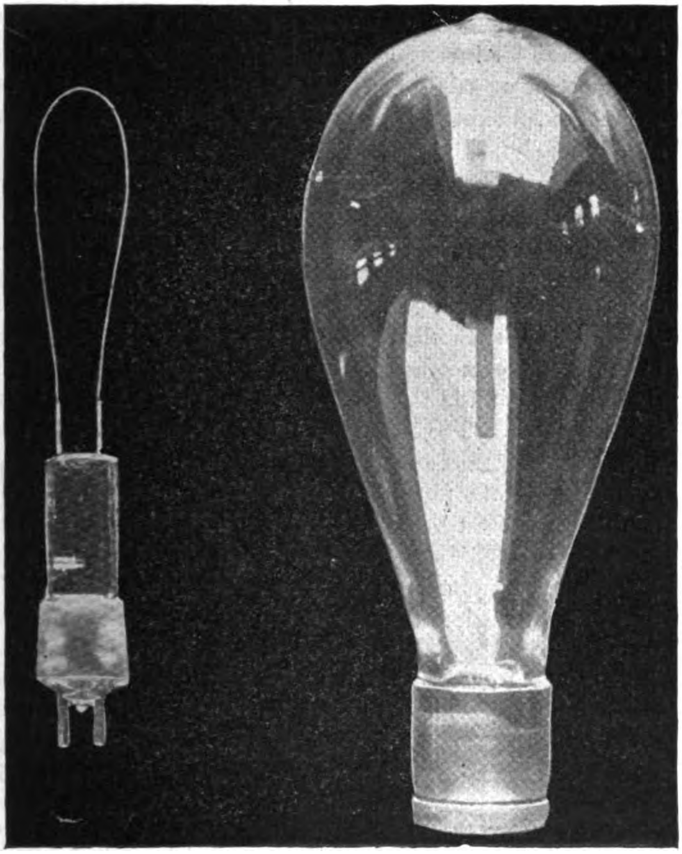
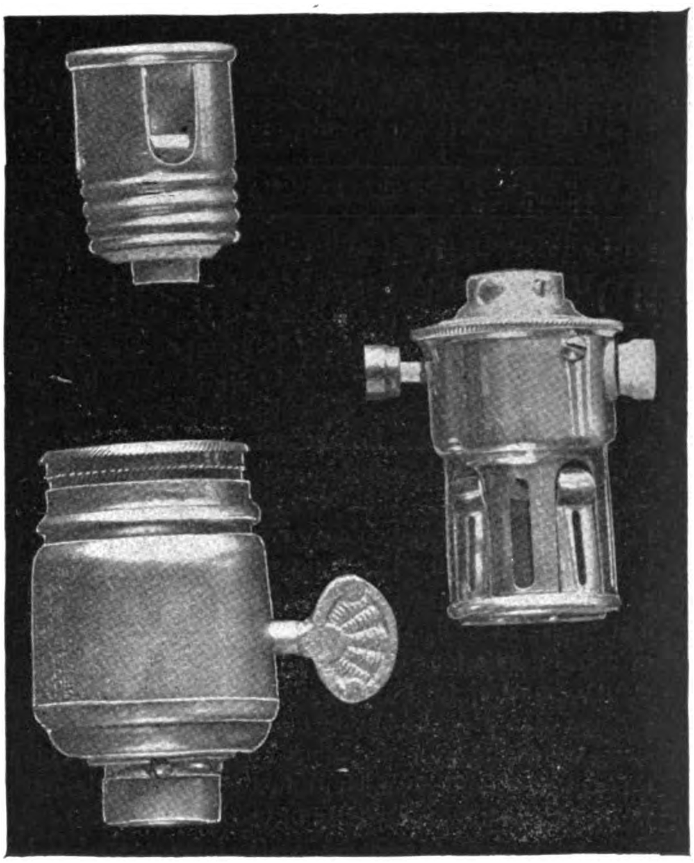


FIG. 2.—STOPPER AND BULB OF NEW WESTINGHOUSE LAMP.



FIGS. 3 AND 4.—SOCKETS FOR WESTINGHOUSE STOPPER LAMP.

(Photographed from Lamp and Sockets.)

As will be seen in Fig. 2, the lamp is complete in itself and can be readily adapted to any type of socket; thus Fig. 1, illustrates the Westinghouse base and socket. The lamp is pushed into the base by which the contacts are made with the leading-in wires; the base is then pushed into the socket, no screw motion being employed. Fig. 3 shows the base employed for use on Edison sockets.

A special and very simple form of pendant switch has also been designed for use with the lamp, as illustrated in Fig. 4. By merely pushing in the white or black button, the lamp is switched on or off, and this can be readily accomplished by the use of but one hand.

"EVER WELCOME".

A WELL known New York medical man writes us "Please find enclosed check for $3 for renewed subscription to your ever welcome ELECTRICAL ENGINEER. Its weekly arrival diminishes my maximum of long felt wants most materially."

THE ELECTRIC vs. THE STEAM LOCOMOTIVE.

BY H. S. A. C.

WHILE sauntering about in the city of Lynn, Mass., not long ago, I saw a unique tug of war contest that I thought might be interesting to the readers of the ENGINEER.

The engineer of a large freight engine doing duty on the B. & M. R. R. had his steam horse coupled to a queer shaped piece of mechanism, which had the general outlines of the old gun boat "Monitor." Later I learned that it was a new electric locomotive that had been built at the Thomson-Houston factory, and that the engineers were giving it a practical test.

When the word "go" was given, on went the steam and "juice" with a jump. The steam engineer up to this time thought that he had an easy opponent, the electric locomotive being so much smaller and apparently lighter, but when he found himself being pulled along by the other he was a little disheartened and looked troubled.

A happy idea brightened up his countenance, and thrusting open the sand box to its fullest capacity, he gave the little electric locomotive more than it could do. But only for a short time, for when the electric locomotive reached the sandy track it started up with new life and pulled the steam locomotive back to the starting point, but no farther; for just as soon as it reached the clean track the steam locomotive would have its sway.

And so it went on, back and forth, until the steam engineer, getting disgusted at being outdone by such a small insignificant rival, without any puffing or blowing or shovelling of coal, left his engine, and started for home muttering about the dangers of electricity and the deadly trolley wire.

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Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue
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Western Editor and Manager, L. W. COLLINS, 575 The Rookery, Chicago, Ill.
New York Representative, 203 Broaway, } W. F. HANKS.
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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XV. NEW YORK, FEBRUARY 1, 1893. No. 248.

GOEBEL.

DURING the past week almost the sole topic of discussion in electrical circles has been the unexpected and surprising character of the defence put in by the attorneys of the Beacon Company to the application for an injunction made in behalf of the General Electric Company under the Edison incandescent lamp patent; in respect to which proceedings were still pending when our last issue went to press. There is as yet but little to add to the very full details of the case which we were able to lay before the readers of THE ELECTRICAL ENGINEER, not only in advance of our contemporaries of the weekly, but of the daily press as well. After listening patiently, and with evident interest for three days, to the affidavits and arguments of counsel, the Court granted a week for printing the papers in the case and for the handing up of briefs and citations of authorities by counsel on both sides. Pending this respite the Beacon lamp factory is doubtless being worked to its utmost capacity of production.

There naturally exists a wide difference of opinion among those most interested, not merely as to the intrinsic merit of the defence presented, as summed up in our columns last week so fully, but as to the effect which its presentation at this late day will be likely to have upon the future fortunes of the Edison patent. As the learned counsel for the complainant took care to remind the Court, there is scarcely a single instance on record of a patent covering an invention of great importance and monetary value, in which a determined effort has not been made to show that some other person had made the invention at a date anterior to that of the patentee; and, as he further remarked, it is also true that few if any of these attempts have resulted in the overthrow of the patent. Not to go outside of our own electrical field, the claim of Jackson to the invention of the telegraph, and that of Drawbaugh to the invention of the telephone, will be recalled as conspicuous examples. In view of such facts as these, the Court must be expected to view the allegations now made in behalf of the prior invention and use of the incandescent lamp by Goebel with unusual suspicion; indeed it would be manifestly wrong for it to do otherwise.

Unless the evidence proves to be so convincing as to leave no room for a reasonable doubt, we do not see how the Court can do otherwise than grant the injunction asked for. At the same time the fact must not be lost sight of, that former cases can furnish no complete precedent for this one. Every such case must be judged on its own merits, and, in the present one, the real inquiry must be as to the truth of the statements sworn to by the witnesses, of the force and pertinence of which every reader may judge for himself, from the abstracts printed in our last issue.

The statute provides that a patent may be granted to an applicant for an invention or discovery only upon the following conditions, among others, viz.: that it must have been "not known or used by others in this country, * * * before his invention or discovery thereof, and not in public use or on sale for more than two years prior to his application, unless the same is proved to have been abandoned."

An inventor, having once made and perfected an invention, may, if he please, use it in private, or he may use it in public, or sell or otherwise permit its use by the public, and never attempt to patent it. Either procedure may constitute what is legally termed an "abandonment" of the invention, such abandonment inuring, in the first case, to the benefit of a subsequent independent inventor, should there be one, and in the second case to the benefit of the general public. The last named state of facts constitutes a "public use," and it is such a use that is alleged to have taken place in the present instance. Hence, there are two points which must be established beyond all possible doubt, in order to overthrow the Edison patent; first that Goebel's lamp was a complete and operative structure, and, second, that it was used in public or by the public more than two years before the invention of Edison. Evidently, the former is to be the main point of controversy, for there can be no question that if Goebel's lamps were operative, and were used in the way that many witnesses affirm them to have been, namely, to attract spectators to look through a telescope for a small fee—described so graphically in our pages last week—it was just as effectually a "public use" as are the hundreds of arc lights which nightly blaze along the Bowery for the avowed purpose of inveigling the passers-by to drop their nickels into the tills of its thrifty shopkeepers. If in the present instance, the evidence and the exhibits are sufficient to convince the Court that Goebel's lamps were operative lamps, and that they were made by him at the time the witnesses say they were made, then it can apparently pursue no other course than to refuse the injunction, and compel the complainant to re-try the original issue on the new evidence now brought forward. In that event it would be, to say the least, extremely doubtful if any result could possibly be reached before the final expiration of the patent. Thus, from the present outlook it seems probable, that within a very short time the ultimate fate of the incandescent lamp patent must virtually be decided.

ELECTRIC RAILWAY DEPARTMENT.

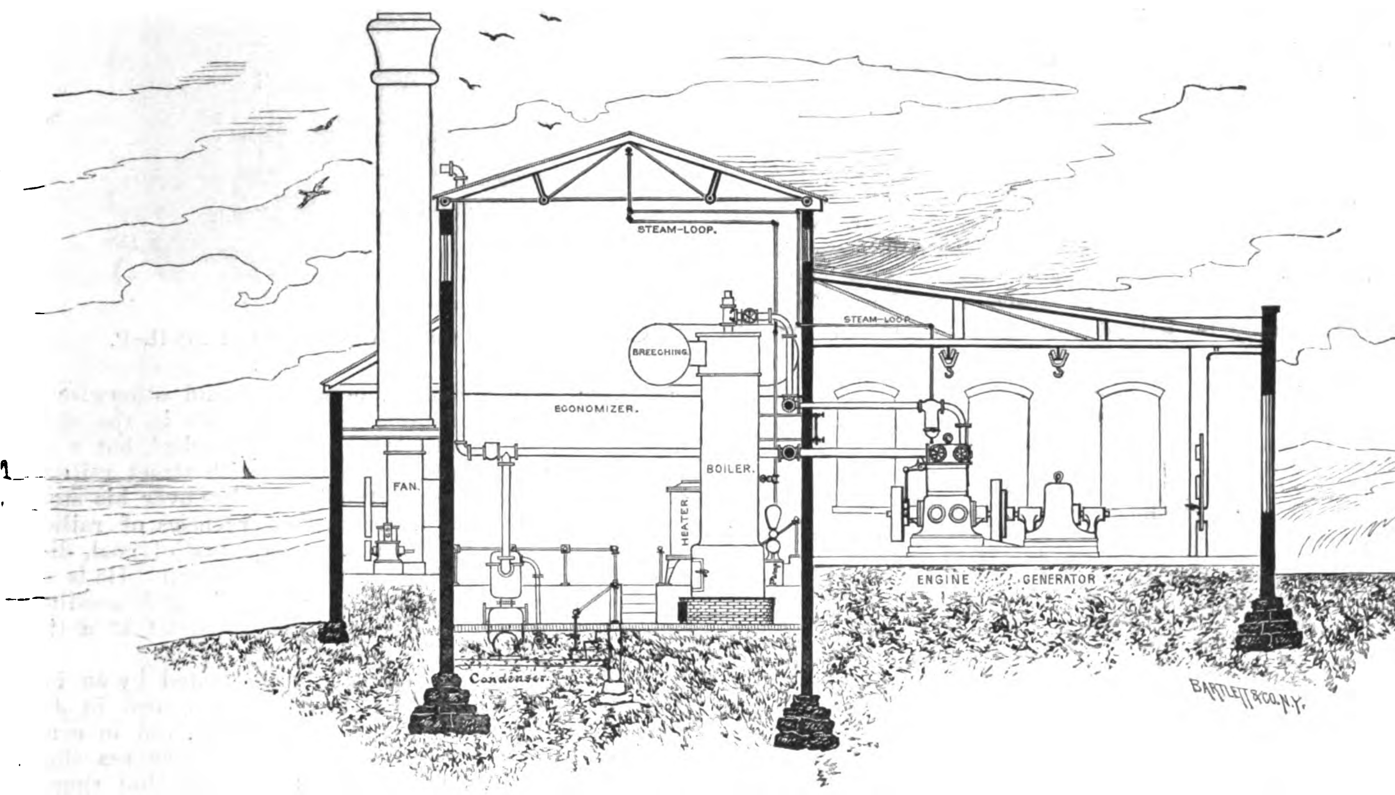
THE POWER STATION OF THE NEW HAVEN AND WEST HAVEN STREET RAILWAY, NEW HAVEN, CONN.

BY

A. C. Shaw.

I.

The New Haven and West Haven Street Railway operate a line of double track road between "The Green" in the city of New Haven, Conn., and a seaside resort known as Savin Rock, in West Haven, with two branches in the residence district, being a total distance of 9¼ miles, of which 4½ miles are double tracked. Their present equipment consists of 42 cars, comprising seven open cars having two motors of 30 h. p. each, and 16 cars equipped with one 30 h. p. motor, nine cars with single 20 h. p. motors, and ten trailers. The road has the usual city and suburban trade throughout the year, and in the summer season it handles a heavy pleasure travel to the Savin Rock resort.



SECTIONAL ELEVATION OF THE NEW HAVEN AND WEST HAVEN STREET RAILROAD POWER STATION, NEW HAVEN, CONN.

The power station which this article illustrates is a remarkable example of modern engineering in this department. So far as known, it is the first power station in this country which has followed the European practice in completely equiping with direct-connected, slow speed dynamos, or "Kodaks"; and the whole design of the plant in its minor details is so thorough a departure from the older lines of practice, as to attract the attention of engineers and railway men throughout the country. The power station was constructed under contract by Messrs. Westinghouse, Church, Kerr & Co.; the work being designed and supervised by Mr. William Lee Church, of the above concern. It is worthy of remark that the contract was awarded on the 6th of April, 1892, and ground was broken on the following day. The contractors, although not formally bound, were under a moral obligation to operate the road electrically on the 4th of July; the company having largely disposed of its equipment of horses, relying on the power plant to handle the holiday crowd. As the event resulted, steam was raised on the 1st day of July, and the road was ready so far as the power was concerned, to take care of the 4th of July traffic, and as a matter of fact did so, to the extent of the full car equipment at that time in service.

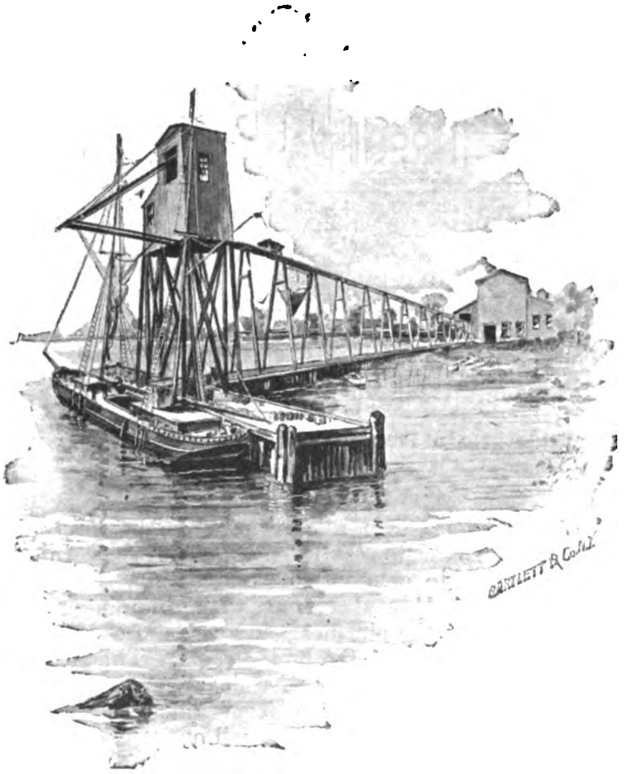
II.

The plant is located on a lot situated at the west end of the West Haven bridge at tide water. A pier runs out 300 feet to the ship channel so that coal may be handled by the cargo. A Hunt tramway with dumping car carries the coal from the pier head and distributes it through a coal pocket outside of the boiler room. This pocket is carried on heavy timbers, with a floor incline at such an angle as to let the coal run freely into the fire-room through openings in the building wall opposite each boiler. A coal supply for ten weeks can be thus stored, or sufficient to tide over any possible freezing of the bay during a severe winter.

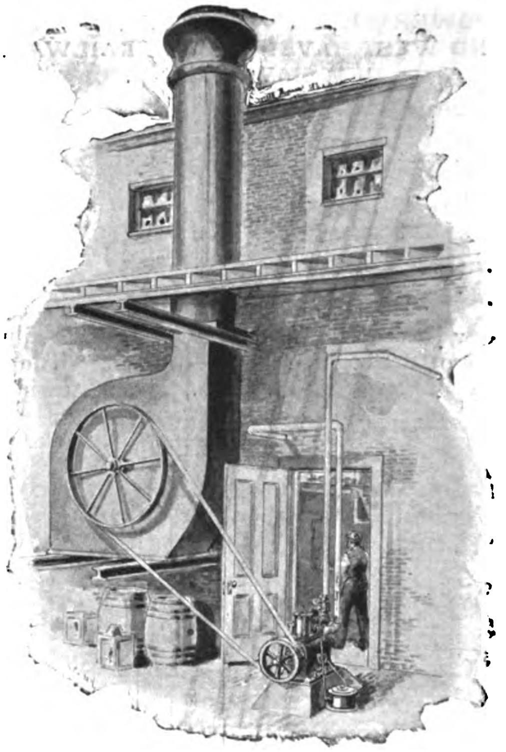
The building is laid out for a total plant of 1,000 h. p. nominal generator capacity; 500 h. p. being installed at present under the original contract. The boiler-room is 72x29 feet with a clear height of 26 feet under the trusses. The floor is of brick laid in cement, being on a level with the grade outside. A slope of about 4 feet in the lot enables the floor of the dynamo room to be raised above the boiler-room, and at the same time to be entered at grade from the front of the building. The boiler plant at present consists of three Manning boilers of 150 h. p. each ; two of which are adequate to run the present plant to its full capacity, the third standing as relay. These boilers are furnished with shaking grates, and an ash car runs on a track within convenient distance of the ash pits.

III.

A most striking feature of this plant is the perfect control of the fires independent of outside conditions, by the use of mechanical suction draft. The observer will be struck by the absence of the usual chimney stack, and will find it difficult to believe that an insignificant steel stack 4 feet in diameter and showing 9 feet above the ridge of the roof, is the only provision for firing the ultimate plant of 750 h. p. of boilers to their fullest capacity. The smoke flues from the boilers are carefully protected by non-conducting material so as to save all the available heat for transference to the feed water in the economizer. The smoke flue after running to the back of the boiler-room turns down into a brick chamber, in which is a Lowcock economizer, the scrapers of which are operated by a little engine on its upper deck. A bypass with damper runs underneath the floor of the economizer, so that the latter can be cut out for repairs without interfering with the boiler service. The cold end of the economizer opens directly into a large slow-running exhaust fan whose wheel is 6 feet, and its case 9 feet, in diameter. This fan stands on I beams in an annex to the boiler-room, and discharges directly up into the bottom of the stack before mentioned. In the base of the stack a steam nozzle may be placed as a relay in case of temporary repairs to the fan, the chances of which may be judged from the fact that it runs in ordinary service at from 40 to 50 turns, and in rare emergencies at 80 turns. At the latter speed the air can be heard to whistle through the ash pit doors, and an intensity of combustion is obtained which practically doubles the rated horse-power of the boilers. The power for the fan is a Westinghouse engine of nominally 5 h. p., but which runs under a throttle barely started from its seat. The actual horse-power has never yet been indicated, but it is nominal. The economizer extracts all available heat from the gases, reducing their temperature in the fan to practically that of the incoming feed water, and returning to the boiler a heat value which would otherwise be required for the production of natural draft in the chimney. The economical results are very marked, but a not less important feature in connection with street railways is the entire control which the fireman has over his steam pressure under all the fluctuating emergencies of railway service. He no longer fears a poor quality of coal, dirty tubes, or dirty fires after a long and hard run. He is not appalled by a heavy snow fall, or by a sluggish condition of the atmosphere which is apt to kill the draft at a time when the tracks are the greasiest.

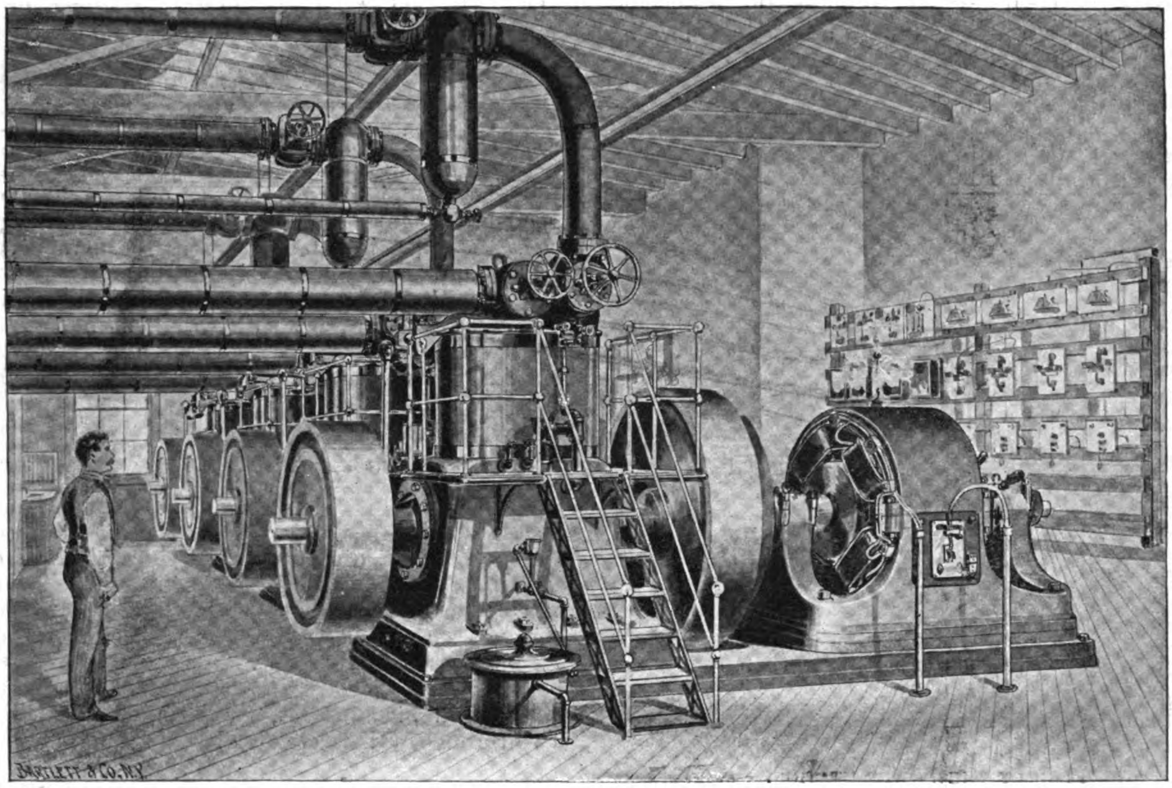


Coal Hoist and Tram.

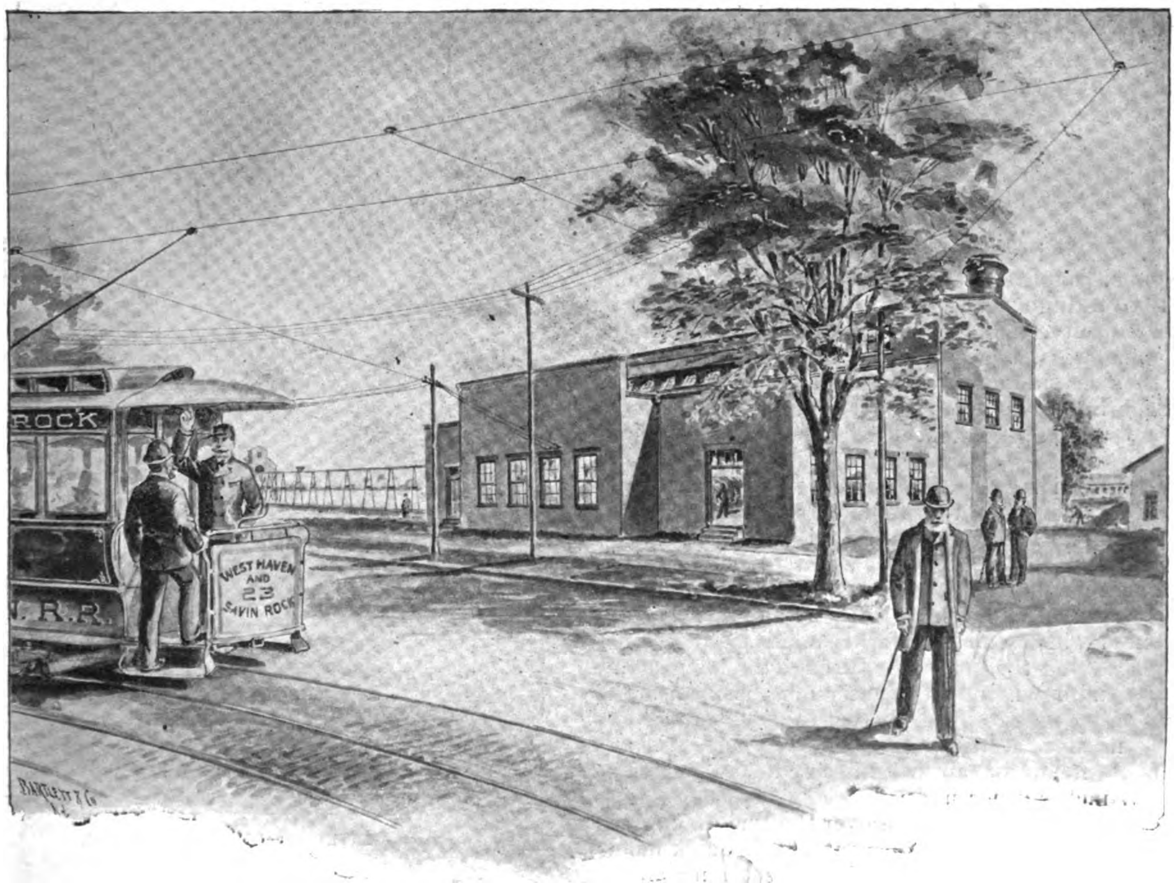


Mechanical Draft and Stack for 750 H. P.

Its capabilities were brilliantly illustrated by an incident occurring shortly after the road was opened in July last. The day was a sultry summer day, and in consequence a large crowd had accumulated at the sea shore. The company had only four motor cars at that time in service ; the remainder of the traffic being taken care of by the horse cars. Several other motor cars were equipped and standing in the car shed, but no motormen had been assigned them. A railway man need not be told that a green motorman will use an extravagant amount of current, and will unlatch the circuit breakers with a frequency which is ruinous to the morals of the man at the other end. In the evening a heavy thunder storm came up and the crowd immediately flocked for the cars. Word was telephoned to the power-house that the crowd was coming and must be taken care of ; that the new cars would be run out with green men and must be handled at all hazards. One boiler and one engine were running ; the second boiler standing banked from the night before, and showing a pressure of 45 lbs. The fan was speeded up a few turns, the second engine immediately started from the same boiler, and the fire hauled down in the second boiler. In eight minutes from receiving the message, the second boiler showed 120 lbs. of steam, and the first boiler had pulled through the double duty and the car service performed was without a break. These facts appeal mightily to the railway manager, who cannot make up for lost time in dealing with the public, but must go for what is in sight each and every moment.


BARTLETT & CO. N.Y.

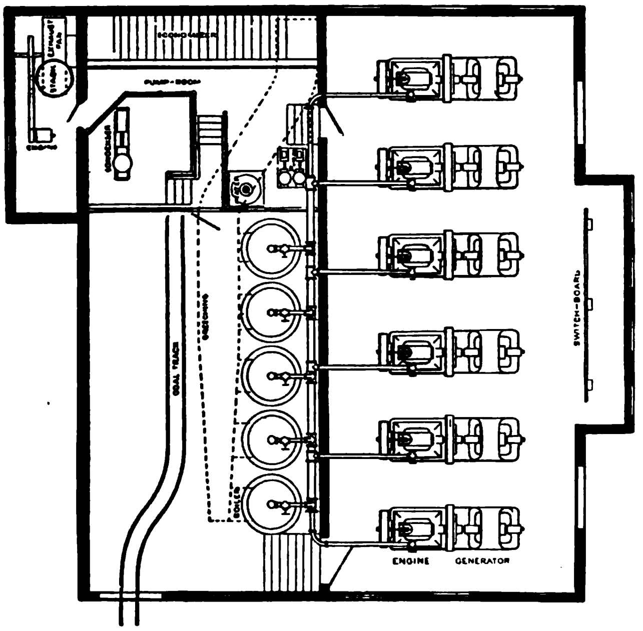
GENERATOR ROOM.


ROCK
WEST HAVEN AND 23 SAVIN ROCK
N.R.R.
BARTLETT & Co

1,000 H. P. POWER STATION, NEW HAVEN AND WEST HAVEN STREET RAILWAY.

IV.

In the boiler-room is the usual double equipment of feed pumps, either pump being adequate to supply the full battery of boilers. These pumps take water through a meter, so that by weighing the coal, and dividing into the water, a running log of the evaporative duty can be taken and reported to the office. The feed water is first carried through a National heater, into which are turned the exhausts from the feed pumps, condenser, fan engine, etc., the whole being sufficient to raise the temperature to about 150°. From the heater it goes through the economizer, and reappears with a temperature of about 330°, in which condition it is fed to the boilers.



Plan of the Power Station.

A pit in the boiler-room contains a Deane independent condenser which receives the exhaust from all the main engines in the generator room. The injection is salt water drawn through a suction pipe from the end of the pier, and discharged to waste; its value being as a producer of vacuum only.

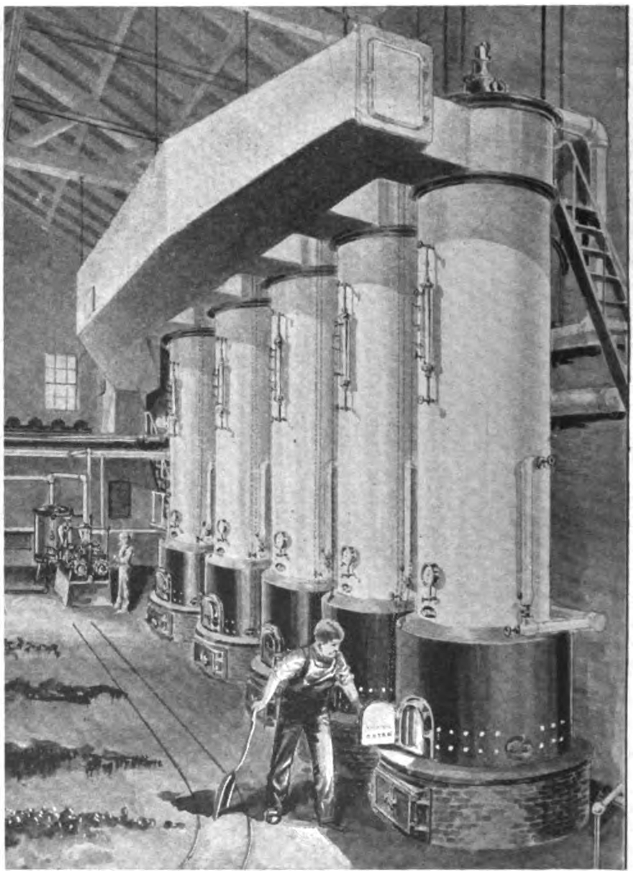
V.

Entering the generator-room, we find a floor space 72 x 31 feet and 16 feet high under the trusses. This room contains at present three Westinghouse compound engines of 160 h. p. each, with a maximum capacity of 200 h. p. on 125 lbs. steam, coupled direct through a flexible insulating coupling to Westinghouse slow-speed generators of 160 h. p. nominal capacity. The room will ultimately contain six of these generators, aggregating a round 1000 h. p. of rating, with a maximum capacity much in excess of this figure. Each Kodak occupies a floor space 6 feet x 16 feet 4 inches, and the arrangement is as shown in the interior view, the distance between centres being 11 feet. A separator is placed in the steam line to each engine near the throttle and an independent steam loop runs from each one, getting its rise in the roof of the boiler-house. Absolutely dry steam is thus insured, all water of condensation or entrainment is returned to the boilers, and the engines are ready to start each morning without annoyance from water. The 12 inch exhaust line is made tight against vacuum by screwing the pipe clear through the flanges and rivetting the end down into a countersink. Expansion is taken care of by copper bends in both the steam and exhaust lines, and since starting the plant not a sign of leakage either of steam or air has appeared, and a steady vacuum of 27 inches is maintained.

A trolley fall runs on an I beam over the line of engines and over the line of generators, permitting of quick handling in case of repairs. An alcove 30 feet long and 6 feet deep contains a skeleton switchboard of quartered oak so located as to be accessible from all sides without projecting into the main body of the room. The floor is laid in diagonal stuff of hard pine, and ample provision is made for artistic lighting on the generators and switchboard, the lighting circuits being on a shunt from the main circuits. The perfection of the engines as to speed is strikingly exhibited by the perfect steadiness of the lights, notwithstanding the rapid and extreme fluctuations of load common to railway service.

VI.

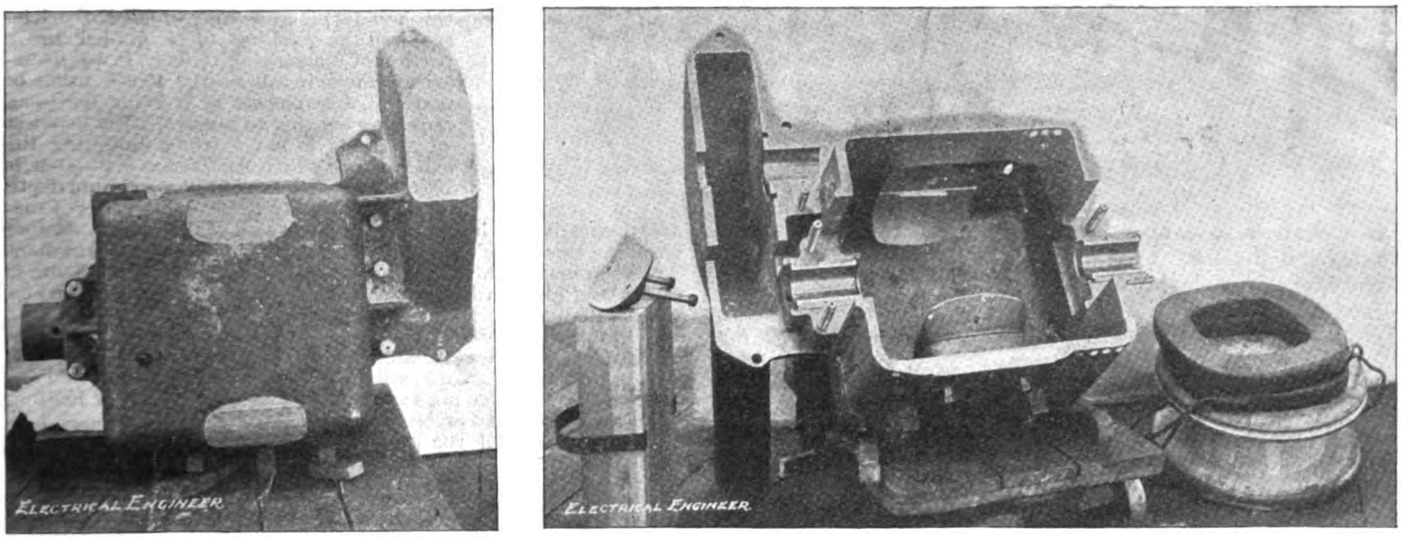
A fact which will strike every practical man, is the remarkably small space occupied by the entire plant. We show here a building 74 x 63 feet outside which contains a 1000 h. p. plant complete, including engines, generators, switchboard, boiler plant with relay, economizer, condenser, feed pumps, and all sundries, including a most generous space for the fire room. On the plan which is still adhered to in many stations of a slow-speed engine driving through counter-shafting, the entire ground area of this whole building would just suffice to contain with fair room for accessibility, a 1000 h. p. horizontal triple-expansion engine *alone*, without any provision whatever for boiler room, counter-shafting, or generators. In other words, the total space under the Kodak design for accommodating the *whole plant* is less than 5 sq. feet per electrical horse-power, or not over one-third of that required for the same equipment on the basis of counter-shafting in a plant of equal size. This for a small plant. A more recent design for a complete power station of 8,000 h. p. generator capacity on a still more compact arrangement reduced to 2.3 sq. feet per electrical h. p. The bearing of this fact upon the cost of real estate, particularly in city plants, and upon the cost of the building, is apparent, amounting to a reduction of fully two-thirds of this heavy item.



Interior of Boiler Room.

The effect upon the capital account is obvious and the next point of interest is the result in the operating expenses. In this particular, the records of the above described station we are told, have probably not been approached by any other station, small or large, thus far constructed.

No official test has yet been made, as the complete car equipment was not in service until the summer rush was over. A detailed test will be made in the summer of '93, but the company has kept running records of the car mileage and coal consumption, which give the essential information. Owing to the non-completion of the pier and the suction line to the condenser, the engines were run non-condensing for some months after the plant was started. During this time an average of almost exactly 2,000 car-miles per day was performed at a cost of coal of exactly $18 ; coal being $3.67 per ton delivered in the bins. This reduces to $\frac{9}{10}$ of one cent per car-mile. About the first of October the condenser was connected, with an immediate reduction to .82 of a cent per car-mile. At the present writing the plant is running on almost exactly four tons of coal per day, gross consumption, including not only banking of fires, steam for pumps, condenser, fan engines, etc., but also the electric *heating* of all the cars in one of the severest winters on record, or slightly less than three-quarters of a cent per car-mile for power, light and heat. This at the comparatively high price of coal prevailing in New England, is a result which demands the thoughtful attention and comparison of railway managers, and very conclusively settles the question of the adaptability of a proper design of compound engine either condensing or non-condensing, to the variable loads of railway service. It further indicates the economical advantage of converting the power in the most direct manner possible from the piston of the engine to the armature of the dynamo, without the frictional losses due to counter-shafting, clutches, etc.



Figs. 1 and 2.—The Curtis Electric Railway Motor; Top and Bottom Views of Case.

VII.

The operating force of the station consists of a chief engineer, who is held responsible for the plant in general, and who is on duty from starting time until 4 p. m., at which time the second engineer goes on and does duty until midnight. There are three firemen running eight hour turns, changing at 6 a. m., 2 p. m. and 10 p. m., the last man acting also as night watchman, and raising steam and starting one engine for the morning run.

The station above described is a bold departure in engineering, but one which rests upon a substantial foundation of practical experience and a full appreciation of the commercial as well as the engineering side of the problem involved. Its success has been marked; and the officers of the company are unstinted in their commendation of the whole plant, and of the contracting firm.

THE CURTIS ELECTRIC RAILWAY MOTOR.

The experience already gained in electric railroading has been sufficient to demonstrate that simplicity in construction and operation of the apparatus, above all else, must be the prominent feature, if lasting success is to be achieved. This becomes apparent when we consider that, unlike apparatus which is housed and well taken care of, as for instance central station apparatus, the electric car equipment must of necessity be placed in charge of men, with little, if any, experience in the handling of machinery.

The functions of the motor-man are simply to operate certain levers to accomplish certain effects, and it is too much to expect of him that he should possess that judgment and discrimination displayed by trained engineers and machinists, who understand the construction and operation of apparatus under their charge; and even if he possessed such a knowledge, the peculiar position in which he is placed and the constant strain upon his mind to avoid accidents to passengers, and to passers by and vehicles on the line of the road, would make the exercise of such judgment frequently impossible. It is of the utmost importance, therefore, that the man should be entirely free from such cares from the time the car leaves the car house until it returns.

With this condition of affairs in view, the Curtis Electric Manufacturing Company of Pacific avenue, Jersey City, N. J., have brought out a new railway motor equipment which is designed to fulfil all the conditions which may be imposed upon this class of apparatus in actual practice.

The accompanying illustration, Fig. 3, gives a view of the motor with the lid raised so as to expose the armature. Fig. 2 shows the body of the motor with all the windings and armature removed. It will be noted that the armature is encased in a single casting in the form of a box with a light cover, thus making a completely water and dirt proof machine. This box of cast steel, ¾ inch thick, has cast on its sides the pole pieces, of which there are two, the motor being a two pole machine. Fig. 1 shows the bottom of the motor case.

One of the prime necessities in a railway motor equipment is the facility for getting at all parts of the motor with the least amount of trouble. To accomplish this the arrangement of the Curtis motor is such that everything can be gotten at and removed through the car floor without running the car over a pit. Thus, for instance, the armature can be raised vertically clear of all obstruction, and this is effected by making the top of the curved pole pieces removable.

One of the most vulnerable spots in an electric motor is the gear case. This is usually cast separately and attached to the motor body by bolts. In the Curtis equipment, however, the gear case is of steel cast integral with the body of the motor and of the same thickness. This not only gives it extraordinary strength and makes it practically indestructible, but, in addition, makes it impossible for the gear case to work loose, as frequently occurs where the gear cases are bolted to the body of the motor.

The motor box illustrated in Fig. 3 is 24 inches square and 21 inches deep including cover. Within the box is placed the armature of the Pacinnoti type. The armature is wound with copper tape which not only greatly facilitates and shortens the time of winding, but also allows of considerable economy in space; at the same time it makes rewinding a very simple process. By this means three sections of the armature can be and are wound with one continuous length of wire.

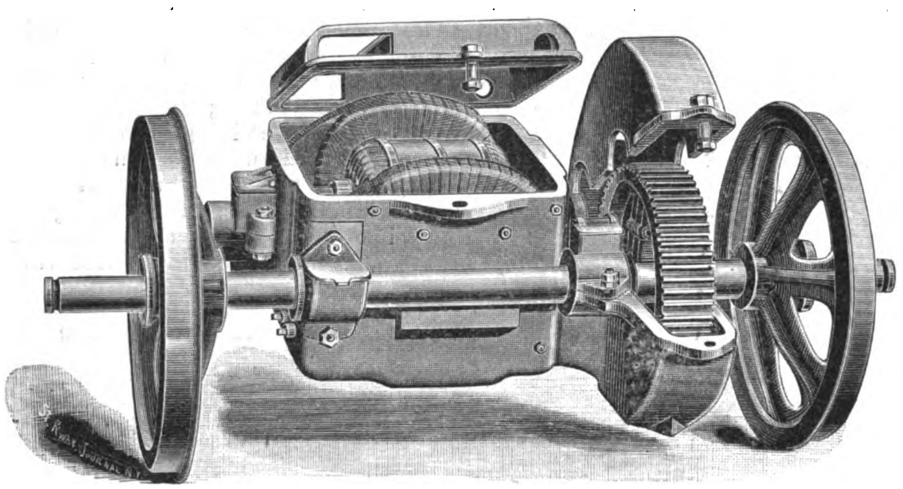


Fig. 3.—The New Curtis Street Railway Motor.

The connections to the commutator are made by means of flexible wire joined to each outlet; the joints are wound with fine copper tape, shellaced and insulated by tape, no solder being used so that repairs can be easily effected. The wire on the armature is wound in mica troughs so that the insulation is perfect.

Owing to the excellent design of the machine only 190 pounds of copper are required for both field and armature, which together have a combined resistance of about one ohm. One reason for the small amount of wire required will be apparent when it is noted that the design of the field is such that the field coils are brought very close to the armature, thus preventing the scattering of the magnetic lines.

The motor is of the single reduction type, the gearing being in the ratio of four to one, and is designed to have a car speed of 15 miles an hour for the average service. The mechanical design has also been thoroughly worked out and the machine is the result of a thoroughly exhaustive study of all the requirements which the practice of the last five years has shown to be essential to successful operation.

EXTENDING ELECTRIC ROADS IN BROOKLYN.

The Brooklyn, Bath and West End Railroad, which was originally known as the Gunther Railroad, and was the pioneer route to Coney Island, has been purchased by E. E. Deniston, the representative of the syndicate of capitalists, which has been investing heavily recently in Brooklyn surface railroads. The road has not made any money for some years, owing to the sharp competition and the amount paid for the property, it is said, was only between $500,000 and $600,000. The route, however, is regarded as one of the finest to the Island, and should the road pass under the control of the new Traction Company, which recently purchased the Atlantic avenue road, and the electric trolley be substituted for steam on the West End road, there would be a complete trolley system established between the South Ferry in Brooklyn and Coney Island. It is understood that this scheme is involved in the purchase of the road.

BY ELECTRIC CAR TO WASHINGTON'S HOME.

Until recently the only means of reaching the home and tomb of Washington at Mt. Vernon, 14 miles below the City of Washington, on the opposite side of the Potomac, was by steamer leaving the city every morning and returning every afternoon. On the 21st of September, however, the Washington, Alexandria and Mt. Vernon Electric Railway opened to the public that portion of their line between Alexandria and Mt. Vernon, affording, in connection with the Baltimore and Potomac Railroad, or the Washington and Alexandria Ferry, a very interesting and much quicker means of reaching Mt. Vernon.

The line, starting at the railroad station, or the ferry landing, passes a number of interesting points of the old historic town to the outskirts of the city on the South, whence it crosses, on an imposing trestle bridge which spans the expanding mouth of Hunting Creek, to the newly-laid-out town of New Alexandria. From this point the line bears southwest through an open and nearly level section for two miles, when it begins to rise and enter a rolling country, passing for several miles through fields, across streams and over wooded heights until the trestle over Little Hunting Creek is reached. Beyond this and just before reaching Mt. Vernon a five per cent. grade some 1,500 feet in length is reached. This ascent made and the terminus of the road, the Mansion of Washington is in sight.

The whole line comprises about 10½ miles of track, most of which, passing through farm lands and wooded districts, required the road-bed to be graded and a portion of it cleared of timber. It was necessary to move in all nearly 40,000 yards of material, a large part of it being hard-pan requiring blasting to remove. The heaviest of the cuts is made while mounting the heights upon which Mt. Vernon is situated, is 700 feet in length, and has a maximum depth of 22 feet. Nearly 10,000 cubic yards of material, mostly clay hard-pan were excavated at this point. Before reaching this cut a deep ravine is crossed requiring an embankment 18 feet in maximum height and about 1,000 feet in length. Some 30 culverts of glazed tile pipe with brick head walls are required on the whole line.

The trestle bridge which spans Hunting Creek and connects Alexandria with New Alexandria is over a half mile in length, 30 feet in width, and affords a fine drive-way to the newly-laid-out town. It is built on piles and has a plate-girder draw of 100-foot span, furnished and erected by R. W. Hildrith & Co.

That portion of the line within the city limits, comprising some 2½ miles of single track and turnouts, is laid with 55-pound and 70-pound Wharton girder rail, supported on chairs resting on ties spaced 2½ feet apart. The remainder of the line from the city line on the south to Mt. Vernon is a single track with turnouts, and is laid with 50-pound Standard T-rail spiked directly to ties. The ties are 6 inches square and spaced 2½ feet apart, and the track is lined, surfaced and ballasted in accordance with present steam railroad practice.

Electric Railway Cut Near Mt. Vernon.

Two supplementary wires of galvanized iron, No. 0, B. & S. are laid, one at each rail, under the ties. The rails are single-bonded at each joint, every bond being connected to one of the supplementary wires. Ground plates made of galvanized iron are sunk every 500 feet and connected to the two ground wires.

In the overhead line construction in the city, octagonal pine poles are used, the trolley wire, No. 0 copper wire, being suspended by spans. Outside the city, round cedar poles are employed, the trolley wire being suspended by bracket arms. The General Electric Company's line material is used throughout. From the station two No. 3/0 feeders run into the city and four No. 3/0 feeders extend southward towards Mt. Vernon, two of them extending a portion of the way only.

The power house, located near the southern end of the long bridge, a short distance from the line, but close to the water's edge, is a brick building, 68 x 92 feet, and contains a car house in addition to the power plant. The latter consists of two 150 h. p. horizontal tubular boilers, furnished and erected by W. P. Fleming & Co., and two Greene engines of 200 h. p. each. The current is furnished by two Edison generators, of 200 h. p. each, belted direct to the engines.

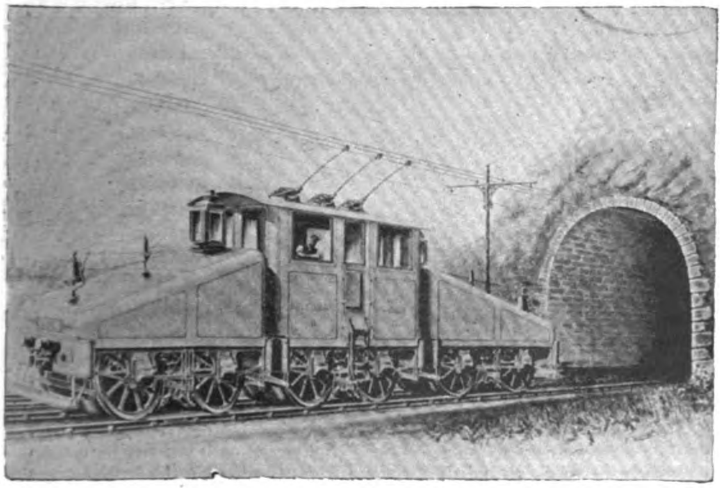
The cars were furnished by the J. G. Brill Company. For city use there are two 16 feet cars equipped with two 15 h. p. W. P. motors furnished by the General Electric Company. For use on the Mt. Vernon portion of the line there are four 34 feet cars, each equipped with two 30 h. p. motors of similar design. The whole work has been planned with the intention of making fast time between Alexandria and Mt. Vernon; and a speed of 25 to 30 miles per hour is readily attained. The construction of the road was undertaken by the Mt. Vernon Construction Company in the month of June, Mr. Chas. H. Davis acting as chief engineer.

On July 5th the contracts for track construction, grading and line construction were awarded to the Woodbridge & Turner Engineering Company. The work of construction was begun on the 16th of July, and in the face of almost insuperable difficulties the work was so far completed that a trip was made to Mt. Vernon on the 20th of September, and the line opened to the public the following day. Considering the magnitude of this work, the especially difficult features that were required to be overcome, and the shortness of the time in which the whole was accomplished, it is believed that it will compare favorably with any electric railway construction of similar character and magnitude that has yet been accomplished. The work was done under the supervision Mr. B. P. Flint for the chief engineer; Mr. A. S. Kibbe having charge of the track construction and grading, and Mr. Herbert Turner, of the line construction, for the contractors; and a large part of the credit for the thorough and rapid completion of this extensive work is due to their energy and skill.

We show herewith one of the grades on the road, the view being taken recently, while heavy snow has been on the ground. In The Electrical Engineer of Dec. 21, 1892, a few details of the road were given with a view of the long trestle bridge in course of construction.

ELECTRIC LOCOMOTIVE FOR THE B. & O.

For some time past the General Electric Company has been engaged in the design and construction of a heavy freight and passenger locomotive, to be operated by electricity, and to be used in the new tunnel under the City of Baltimore. It is required of this electric locomotive that it shall handle regular passenger trains and also assist steam locomotives in the haulage of heavy freight. In view of the great interest taken in the subject, we are glad to republish from the *Forum* magazine for February, the first illustration of the locomotive to appear. It will be seen that while adhering more or less to conventional lines of construction, various departures from orthodox practice have been made, chiefly, it may be pointed out, in dividing up the power and in applying it to the axles by a number of motors each driving directly by an armature on its own axle. The trolley arrangement is of familiar type, the chief novelty lying again in the principle of subdivison, adapted to secure continuity of contact with such a heavy current as will be required for the work.

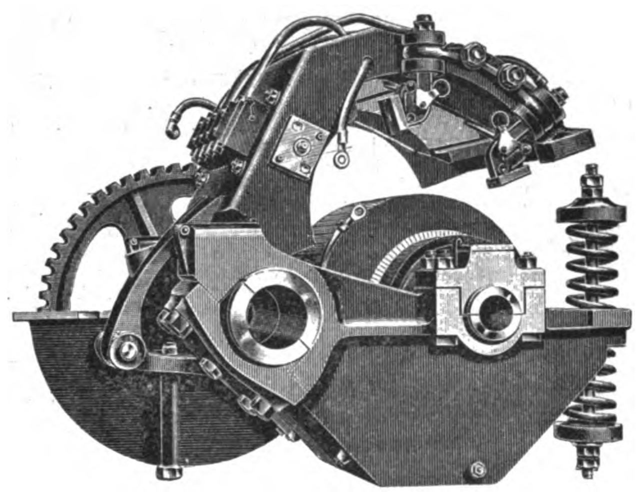


Electric Locomotive for the B. & O.

THE GRÜTSCH & MÜRREN ELECTRIC RAILWAY IN SWITZERLAND.

Concerning the electric railway recently built near Lauterbrunnen, Switzerland, 5,000 feet above the level of the sea and commanding a view of the magnificent Jungfrau chain, *Industries* makes moan as follows: "It would seem that the Swiss are bent upon spoiling their country as much as possible. Whenever they find an inaccessible precipice they run a railway up it. They are proposing a railway up the Jungfrau itself. The Philistinism of the American who was shocked at the bad engineering of the Tower of Pisa, and who sent in an estimate for making it vertical, pales before that of the Swiss railway projector."

We quite agree with our contemporary that there are places where railways of any kind are out of place, especially on the faces of "inaccessible precipices;" still, if the grandeur of the Swiss scenery is to be eclipsed by impossible examples of engineering skill, it is, perhaps, well that the latter should be constructed in a manner worthy of their surroundings.



The Oerlikon Railway Motor.

The road in question was built by the Oerlikon Company and is of the ordinary single trolley system. The generators employed are multipolar machines with drum armatures, with the conductors connected across so that two brushes can be used. The lower part of the field magnet is cast on the bed-plate, and the bearings are mounted on round-footed pedestals which fit upon surfaces bored at the same time as the field magnets.

The type of motor used is shown in the accompanying illustration. The field is made of two steel castings for the sake of lightness and compactness. A single reduction gear working upon a four inch axle is employed. The field magnet coils are wound on strong insulating material compressed in special moulds. The armature is wound with embedded wires. Notches are employed with openings sufficiently large to admit the wire without threading, several wires being arranged in each notch; and carbon brushes are employed.

The axle gear is of steel, with a phosphor-bronze pinion having teeth of a new shape which are said to work noiselessly and without "play." The motor is mounted on a truck with 30-inch wheels, and its lowest point is 3¼ inches above the level of the top of the rails. The length is also small, so that a pair of motors can be easily mounted on a bogie with a five foot wheel base.

The controlling gear has a double motion, and is designed for a 600-volt circuit.

FROM BUFFALO TO NIAGARA BY ELECTRIC CAR.

The Buffalo and Tonawanda Electric Railway Company has filed its papers of incorporation. The company will build an electric railroad, four miles long, beginning on the Military Road at the city line of Buffalo, and terminating at the northerly line of North Tonawanda. The capital stock is fixed at $100,000, consisting of 1,000 shares of $100 each. The directors for the first year are: Frederick Swift and Wendell Goodwin, New York; G. H. Wirth, Brooklyn; W. P. Whitlock, Elizabeth, N. J.; L. P. May, New York; Francis Gilbert, East Orange, N. J.; the Hon. W. Caryl Ely and Frank A. Dudley, Niagara Falls, and Charles A. Leh, New York. This railway is a part of the line which, in connection with the North Tonawanda Electric Street Railway and the Niagara Falls and Suspension Bridge Street Railway, is to form a through line from Buffalo to the Falls, the tracks of the last named companies being used by virtue of a traffic arrangement just made. When completed the road will be one of the longest electric railways in the United States and will run through a well populated and growing country which, with the using of power from the Niagara Falls Power Company as intended, should make the road a very profitable one.

MORE ELECTRIC CARS FOR NEW ORLEANS.

PRESIDENT H. M. LITTELL of the new Electric Traction Company formally took charge of the company's property in New Orleans on Jan. 13. President Joseph A. Walker of the New Orleans City and Lake Railroad turned over the affairs of the company to the purchasers, represented by Mr. Littell. The property consisted of 66 miles of street railroad, 182 cars, 867 mules, seven dummy engines, 36 passenger coaches and other cars. Some $200,000 in cash and stock were also included in the transfer.

The Traction Company has virtually been in charge since the 1st of January.

The City Railroad has been in existence since June 5, 1860, and its history justifies the confidence in the reward for enterprise to be obtained in New Orleans. Col. Joseph A. Walker was elected president, and has served the company for twelve years. During his administration the West End has been improved. The Prytania and Magazine St. lines have been extended, the property of the company bettered in every way, the debt paid off, a surplus of $200,000 secured, and the stock finally sold to the Electric Traction Company at $150 a share. In a few days the electric concern will form its plans and work will be begun without delay.

The Prytania street line will be the first to be converted into an electric system, and the others will be constructed as rapidly as possible. It is proposed to build the roadbed in the most solid manner, and to equip the tracks and every branch of the new service with the best and most modern accessories.

NEW ELECTRIC RAILWAY IN PHILADELPHIA.

MAYOR Stuart, of Philadelphia, having signed the ordinances for The Elmwood and Fairmount Park, and The Fairmount Park and Haddington roads, they will be the pioneer roads in Philadelphia to be equipped with electric motors, among the many suburban roads now projected. Though the Bainbridge street line has been equipped and is now in operation with the "trolley" system, yet these two roads will be the first which will have the official sanction of the Mayor of Philadelphia, and it is proposed by the Directors to construct and equip them as model suburban roads.

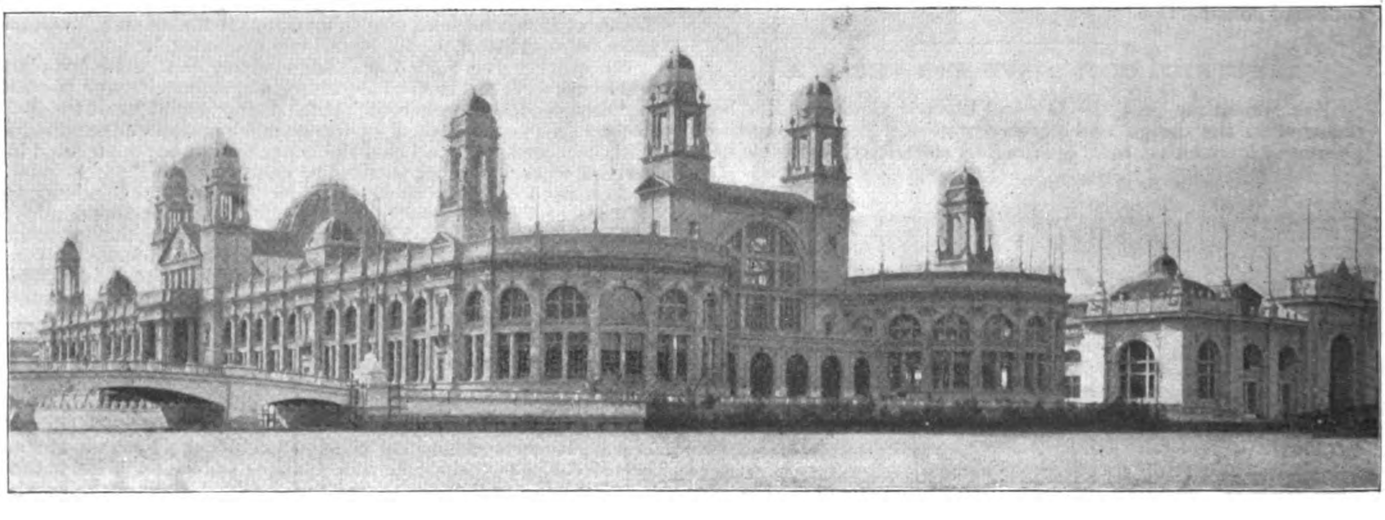
The entire lines with extensions will be some sixteen miles in length and it is proposed to begin operations in June with about twenty cars. The lines will form a connecting link between the large territory lying South and West of the 52d Street station of the Pennsylvania Railroad, and the lines of the Traction Company and of the Pennsylvania Railroad Company, with a branch to George's Hill, Fairmount Park.

The entire construction and equipment of these roads has been placed in the hands of the Neftel & Marsh Company of New York.

WORLD'S FAIR DEPARTMENT.

A FEW DETAILS ABOUT THE WORLD'S FAIR LIGHTING.

AROUND the Grand Basin of the Chicago World's Fair are grouped nearly all of the largest and most important of the exhibit buildings. Across the east end stretches the long colonnade of the Peristyle with the great arch of the Porticus Columbus in the centre. On the north side are the Music Hall and the shorter facades of the Manufactures, Electricity and Mining buildings. At the west end, the head of the basin, stands the Administration building, and on the south side the Casino, Agricultural and Machinery buildings.



ELECTRICITY BUILDING, WORLD'S FAIR, CHICAGO.
(Photographed from the Water Front.)

The cornices of these buildings on the side fronting the basin and the South Canal are outlined with incandescent lights. Those are of 16 c. p., and are placed two feet apart, and at such an angle as to give the most effective results as seen from below. A series of experiments was made to show the best spacing and angle, and it was found that lights at intervals of two feet and set at an angle of 30 degrees from the horizontal would be the most satisfactory. There are about 4,800 lights used on the cornices of these buildings distributed approximately as follows:—Peristyle, 300; Music Hall, 100; Manufactures, 500; Electricity, 350; Mining, 200; Administration cornices and dome, 1,500; Machinery, 950; Agriculture, 800; Casino, 100. A special porcelain socket is used for these lights, provided with insulating feet to raise it above the surface of the roof. The wires are strung from one socket to another and have no other supports nor insulators, the socket answering for both. These sockets have been subjected to severe tests, such as being operated for some time with both lamps and sockets entirely immersed in water without rubber shields or other protecting devices, and have proved quite satisfactory. The circuits on the cornices are sub-divided so that nowhere are there more than about twenty lights on one fuse. The feeders supplying these lights are run on glass insulators inside the hollow walls of the buildings, doors being provided to render them accessible at all times for inspection and repair.

The Peristyle is a long colonnade of lofty columns fifty feet in height, which divides the Grand Basin from Lake Michigan, and connects the Casino Building with Music Hall. The columns are arranged in four parallel rows, the spaces between forming a grand promenade. In the richly paneled ceiling sixty feet above the floor hundreds of incandescent lights are arranged singly and in clusters according to the architectural requirements. Owing to the great height above the floor which renders them inaccessible from below, special means of reaching them to renew burnt out lamps were required. The single lamps were arranged to be withdrawn from above, and clusters are disconnected at the cut-out above and lowered to the floor. To supplement these ceiling lights and also to produce certain desired effects, a vertical row of lights is placed in one of the deep flutes of each column on the side towards the centre passage. The flutes in which the lights are placed are so deep as to entirely hide the lamps from the view of a person standing at one end of the passage, only the bright glow being visible. The Columbus entrance, as the grand arch over the inlet which connects the waters of the Basin with those of Lake Michigan, is called, is finely treated with lights set in the panels, the reflection in the water below adding to the beauty of the whole.

On each side of the Basin at a grade somewhat lower than that at which the buildings are placed is a broad terrace tastefully laid out in flower beds and adorned with fountains and statues. These flower beds are to be outlined with lights set in the grass 12 inches apart. About 2,500 lamps of 10 c. p. will be required for this purpose. They are wired in such a way that they can be readily taken up and replaced when it is necessary to mow the grass.

Not the least among the beautiful light effects that will invite the admiration of the beholder, will be those introduced on the walls of the Basin itself. These walls are perpendicular and are built of piles and planking covered with staff in such a manner as to give them the appearance of having been built of hewn stone. The broad capstone of this wall projects over some five or six inches, and under this "nosing" is placed a row of lights 18 inches apart and at an angle of 45 degrees. This row of lights runs entirely around the Basin on docking and bridges, being broken only at the places where the broad stairways descend to the boat landings.

It is when we reach the upper end of the Basin directly in front of the Administration building that we come to the spot that will attract crowds by day and about which at night will gather all sorts and conditions of men, women and children in undisguised admiration and open-mouthed astonishment. In the centre stands the beautiful allegorical fountain of McMonnies upon which two powerful search lights will be turned, and on each side of this is a great electric fountain, each containing 152 jets and each illuminated with 18 immense arc lights of about 100,000 c. p. each, requiring 90 amperes of current for their operation. The lights, and the mechanism for controlling the water, are all located under the fountain. The pipes supplying the jets are placed within, and concentric with a larger tube through which the beam of light is thrown. An operator stationed in the tower of Machinery Hall will be in communication with the operators under the fountain and will signal to them the various combinations desired. A main 36 inches in diameter has been laid to supply these two fountains and the central jets will at times reach the enormous height of 150 feet. Without indulging in extravagant language or sentimental gush, it may be said that the effect produced by these 300 colored jets, will be one which once seen will never fade from the memory. Nothing to compare with it has ever been seen, and it is possible that another centennial may elapse before it will be exceeded.

High up on a gilded ball on the dome of the Agricultural building stands the great golden Diana which once graced the top of Madison Square Garden in New York. The dome upon which she stands is surrounded near its top by a low parapet which forms a circle about 30 feet in diameter. Behind this parapet, and about the inner circumference of it, are placed a circle of incandescent lamps provided with reflectors to throw the light upon the figure, the source of the light being invisible from below.

The main principle running through the whole scheme of lighting of the Exposition is that lights should be used only in such ways as will bring out more clearly some peculiar beauty of art or nature. Fancy designs in which the lights themselves are the main objects of attraction have been carefully avoided, and every thing made to harmonize as far as possible with the designs of the artists and architects.

L. W. C.

COMMITTEES FOR THE CHICAGO ELECTRICAL CONGRESS.

At the meeting of the Advisory Council of the Chicago World's Congress of Electricians, four committees were decided upon to take up the active work in connection with preparations for the Congress. These Committees were, the Finance, three members; Executive, five members; Invitations, five members; and Programme and Papers, eight members. Dr. Elisha Gray, Chairman of the Advisory Council, has now selected the following members of these Committees, from the Advisory Council and his local Chicago Committee:

Executive Committee.—Prof. Elihu Thomson, Enos M. Barton G. M. Phelps, F. S. Terry and Prof. B. F. Thomas.

Finance Committee.—B. E. Sunny, Prof. E. J. Houston and W. A. Kreidler.

Programme and Papers Committee.—Prof. H. A. Rowland, Prof. H. S. Carhart, Carl Hering, A. E. Kennelly, Prof. W. A. Anthony, Prof. F. B. Crocker, Prof. E. L. Nichols and Prof. T. C. Mendenhall.

Invitations Committee.—T. C. Martin, Dr. Louis Duncan, Prof. C. R. Cross, T. D. Lockwood and C. H. Wilmerding.

Of all these Committees, and any others that may be formed, Dr. Elisha Gray is a member *ex officio.* He will participate actively in the work of each. It is proposed to establish headquarters for the Congress at Chicago at an early date, at which Mr. R. W. Pope, the secretary of the American Institute of Electrical Engineers, will probably be stationed to carry on all the detail work in conjunction with Prof. H. S. Carhart, the acting secretary.

SOCIETY AND CLUB NOTES.

ELECTRIC METERS BEFORE THE CHICAGO ELECTRIC CLUB.

The meeting of the Chicago Electric Club held on Jan. 14th, was devoted to a description and discussion of meters. Mr. P. J. McFadden read a paper describing the Thomson recording wattmeter. He began by showing what was required in an instrument of this kind to fulfil all demands of practice, and then showed in detail how they had been carried out in the now well-known Thomson meters.

He was followed by Mr. John F. Gilchrist, who had prepared an excellent description of the Edison electrolytic meter, entering into all the details of its construction and operation.

Then came Mr. Chas. Wirt, who described the Aron meter, showing its method of operation and construction, and giving the results of tests which he made on it.

NEW YORK ELECTRICAL SOCIETY.

The 151st meeting of the Society will take place on Wednesday, Feb. 8, 1893, at 8 p. m., at Columbia College, Madison ave., and 49th street.

The evening well be devoted to an experimental and illustrative lecture on "The Telephone, and How We Talk from New York to Chicago."

The subject will be divided in two parts to be given respectively by Mr. J. J. Carty, Electrician of the Metropolitan Telegraph & Telephone Company, of New York, and Mr. F. A. Pickernell, Engineer of the American Telegraph & Telephone Company, (Long Distance Company.)

The following is a synopsis of the lecture:

Part I.—By Mr. Carty: The Nature of Sound and the Mechanism of Speech.—Its Propagation and Reception by the Ear.—The Physiology of the Ear.—The Evolution of the Telephone from the Speaking Tube, the String or Lover's Telephone, to the Electric Telephone.—Description of the Bell Receiver and Battery Transmitter.

Part II.—By Mr. Pickernell. Description of Telephone Lines in Use prior to the Opening of the New York-Chicago Line.—How the Size of the Wire and other details of the Chicago Line were determined.—Description of the Line in detail from Columbia College, New York, to the exchange in Quincy street, Chicago, with Stereopticon Views.

Through the kindness of the Long Distance Telephone Company, the Chicago telephone line has been placed at the disposal of the Society for the evening, and telephone receivers distributed throughout the room will enable the audience to hear speech and music transmitted from Chicago.

Members are at liberty to bring ladies. Cards of admission can be obtained on application to the secretary of the Society, Mr. G. H. Guy, Room 812, No. 203 Broadway, New York.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES.—TELEPHONE LECTURE.

On Friday Jan. 21, Mr. Edward H. Lyon, lectured on the Long Distance Telephone at Association Hall, Brooklyn, before the Brooklyn Institute. The lecturer was introduced by Mr. James Hamblet, who presided. Mr. Lyon, with the aid of lantern slides, illustrated the Blake and Bell transmitters, showed telephone circuits. methods of pole construction, cables, the workings of a telephone exchange and the general detail of telephonic communication. He had thrown onto the sheet views showing the points through which the telephone line from Association Hall to Chicago passed, the two last views being the offices of the American Telephone & Telegraph Co., at Chicago.* Following the lecture, communication was established with Chicago, and a member of the Theodore Thomas orchestra played the cornet, the sounds of which were distinctly heard in Brooklyn. The applause at the close of the solo was tremendous; and on Mr. Hamblet's remarking that this was the first time in the history of the world that sound had been transmitted so great a distance to such a large audience, a renewed outburst testified the appreciation of those present at the triumph of engineering skill that had made this possible. At the same moment a concert was given to Chicago by the Phipps Musical & Lyceum Bureau at Union Square, New York, and the Brookly audience was put into circuit. Among those taking part was Harry M. Peckham, a gentleman well known in electrical circles, who gave a whistling solo, accompanied by banjo, every note of which was easily heard both in Brooklyn and Chicago. The portraits exhibited by the lantern were those of W. D. Sargent, J. C. Reilly, J. E. Hudson, J. J. Carty, F. A. Pickernell, Prof. A. G. Bell, and the group taken at the opening of the line last October, with Mr. E. J. Hall in the foreground.

CANADIAN ELECTRICAL ASSOCIATION.

THE above association met at Toronto last week, to carry out the programme printed recently in our columns. An interesting meeting was had, and the papers while not dealing with anything specially new, embodied a number of points of value. There were about 40 members and visitors present, who were entertained by the local Edison Co. and other electrical interests.

ST. LOUIS ELECTRIC LIGHT CONVENTION.

THE new St. Louis Electric Club is making various arrangements for the coming convention, February 28 to March 20. It has been decided to have the Tesla lecture on Wednesday, February 28, probably in the Music Hall. A banquet is proposed for Thursday, but it is to be hoped that the idea will not be pushed. President Ayer estimates that about 300 members and visitors will be in attendance at the Convention.

At the last meeting of the Chicago Electrical Association, the following were installed as officers for the ensuing year: President, Albert Scheible; vice-president, F. S. Hickok; secretary, M. B. Speir; Treasurer, L. G. Bassett. The topic for discussion on February 14, will be "Arc Light Carbons."

LEGAL NOTES.

NO DISCRIMINATION TO BE PERMITTED IN LAMP SALES.

THE policy of the General Electric Company as to sales of lamps was disclosed last week by the following circular issued to supply houses and others by that company:

> *Gentlemen:*—You are hereby respectfully notified that until further notice, orders for incandescent lamps will be filled by us only when coming from actual users of the lamps.
>
> Yours very truly,
> CHAS. T. HUGHES,
> District Manager.

It has been understood that the same policy will be made to apply to other lines, and that the General Company has notified various parties that if it does not get the order for generating apparatus the supply of necessaries to run it, so far as the General Company controls such supplies, will be withheld.

The first definite attempt to put in force such a policy as regards an actual consumer of lamps, has been made in Chicago and appears to have broken down. The Sunbeam Incandescent Lamp Company, of Chicago, which was recently put under a restraining order that prevented sale but not manufacture. The Sunbeam Company had been furnishing lamps to the National Electric Construction Company. The latter being unable to secure lamps from this source, turned to the Edison Company, which refused to sell and issued an announcement that no one else could use Edison lamps but itself.

Thereupon the National Electric Construction Company applied to the courts for protection and relief, and the case came before Judge Grosscup in the United States Circuit Court. The question was argued by Mr. F. W. Parker for the National Company and Mr. Beale for the Chicago Edison Company, the latter stating that it was in no way concerned in the affairs of the General Electric Company but had paid $300,000 for the exclusive right to handle Edison appliances in Cook County.

After argument, Judge Grosscup said: "The court wishes it understood that it will not permit an order to issue from this court to close up the plaintiff's plant or interfere with the use of the appliances it has paid for. The provisions of the restraining order issued recently apply only to the sale of lamps, and I shall refuse to issue an order calculated to discontinue the operation of plaintiff's plant." Judge Grosscup remarked also that if the Edison Company could not supply the National with lamps, he would see to it that the latter could secure a market from which to draw supplies. Hence the National Company will not take Mr. B. E. Sunny's advice to "lay down or sell out" but is adopting his third proposition, of "fighting."

The next day Attorney G. N. Morgan appeared for the National Construction Company, and the only move of importance in the case was made by him when he asked the court for direction as to the means his clients should adopt to relieve themselves from their present need for lamps. The court then said to Mr. Morgan: "If you will apply to the Edison Company for lamps and they refuse to furnish them, or state that they cannot fill your order, I will release the Sunbeam Company to the extent of allowing them to fill the order for you."

"In a few days we may need another supply of lamps," said the attorney.

"Then come to me again and I will see that you get them," replied the court.

The same determination was expressed by Judge Grosscup, to Mr. Parker:

"I think you had better make out a list of all the lamps you need to resume operations and present it to me. I will add to it the number I think a fair one for you to have in stock for changes. Then you may present the order and tender the money to the Chicago Edison Company, and if you do not secure your lamps the court will take action."

THE Chicago *Evening Post* of January 26 says:—

After leaving Court Attorneys Parker and Morgan, for the National Electric Construction Company, appeared at the local offices of the Edison Company and made their demand for incandescent lamps at 42 cents apiece. The Edison people demanded 50 cents and would go no lower. Then the attorneys served notice that the matter would be brought before Judge Grosscup this afternoon to compel the Chicago Edison Company to sell lamps at 42 cents. At 2 o'clock the Edison Company gave in and its representative sent word to Attorney Morgan that the National Electric Construction Company could have any number of lamps at 42 cents each for an indefinite period. This is considered as a great victory for the anti-combine people.

IN order that it may spot consumers of lamps other than those of Edison make, and it would appear, to draw the trade wholly into its own hands, the General Electric Company has sent out a reply postal card, to every known user of incandescent lighting. It runs as follows:

> HARRISON, N. J., Jan 25, 1893.
>
> ON the attached card, we give information regarding your plant, according to our statistics.
>
> As we are very anxious to test the accuracy of our records, we would be pleased to have you verify the same, and if correct kindly return to us. If incorrect, we would be pleased to receive any remarks you may be kind enough to make.
>
> If you do not wish to oblige us in this matter, please return the card, so that we may know you have received it.
>
> Very truly yours.
> EDISON GENERAL ELECTRIC COMPANY.
> Lamp M'f'g Dept.

The information sought on the card is as follows: "Name; address; business; kind of plant; estimated capacity of dynamo, and maker; plant, when installed; estimated number of 16 c. p. lamps connected; other candle-power lamps; voltage; approximate number of Edison lamps consumed years ending 1889, 1890, 1891; Remarks: Correct except as to." Across this in one corner is written: "We would be pleased to have blank spaces filled in. E. L. W."

INCANDESCENT LAMP LITIGATION.

THE GOEBEL DEFENCE.—EDISON ELECTRIC LIGHT COMPANY (GENERAL ELECTRIC COMPANY) *vs.* BEACON VACUUM PUMP AND ELECTRICAL COMPANY IN U. S. CIRCUIT COURT, BOSTON, JAN. 24 AND 25.

Counsel present for complainants, F. P. Fish, C. E. Seward, and R. N. Dyer. For defendant. L. D. Brandeis, W. C. Witter and W. H. Kenyon.

UPON the opening of court Tuesday morning, January 24, Mr. Witter resumed his reading of the affidavits presented for the defence, commenting upon the corroboration of the details of Goebel's story found in them, and interspersing his reading and comment with argument from the facts shown. He dwelt especially upon the undoubted filamentary character of the carbon conductor in the Goebel lamp exhibited to the court and which was stated by the experts to be from 8 to 10 thousandths of an inch thick—or only half the thickness of the filament shown in the Edison patent.

MR. WITTER presented an affidavit of H. S. Kaliske, business manager of the Beacon Company, stating the capacity of its lamp factory as 3,000 per day, and denying that, as alleged by the prosecution, the company had accumulated a lamp stock ahead and was running the factory night and day. He also read the deposition of D. C. Voss. Mr. Voss being in Boston had heard of the hearing in the present case and came into court as a spectator. Having been employed in the American Company's shop under Mr. Crosby in 1881 and 1882, and finding the Goebel matter up as a defence, he offered his testimony to the defendant's counsel. Mr. Voss testified that he knew Goebel as early as 1874 or 1876, and he corroborated many points of the statements in the affidavits of Henry Goebel and others.

Complainant's counsel read affidavits in rebuttal. They were by Prof. Elihu Thomson, John W. Howell and John E. Randall.

Prof. Thomson, in his affidavit, said that he had read the affidavits of Henry Goebel, F. L. Pope and C. R. Cross and had heard read many other affidavits produced by defendants. He had also examined the three lamps exhibited. He remembered Goebel as far back as 1881 or 1882 and thinks he saw him then. Goebel was then employed by the American Electric Light Company in New York, which company had been started by Mr. Crosby (whose affidavit was filed in this case) and a Mr. Fox; it afterwards combined with the Eastern Electric Manufacturing Company—owning the Sawyer-Man patents—forming the Consolidated Electric Light Company. The manufacture of lamps was afterwards turned over to the Sawyer-Man Company which company had recently been enjoined by the U. S. Court of Appeals in New York. Prof. Thomson had visited Goebel's shop in 1881 or 1882. He had little faith in the Goebel story at the time, although the officials and employés of the American Company expressed their reliance upon it as a defence against the Edison patent. He felt sure the three lamps now exhibited were never practically operative; they might have burned a little, but the Goebel lamps could never have been practically used. They could not hold a vacuum for any considerable period; leaks would at once develop around the sealing-in of the iron and copper leading-in wires.

Mr. Howell and Mr. Randall, technical experts of the Edison Lamp Works and Thomson-Houston Lamp Department, respectively, in their affidavits said that they had examined the Goebel lamps exhibited and had read Prof. Thomson's affidavit and that they concurred with everything that he had stated as to the structure and effects of the exhibits.

Respecting the alleged knowledge of Goebel and his work on the part of the defendants in the New York suit (the United States Electric Lighting Company) and their failure to allege prior use by Goebel as a defence, Mr. Witter read an affidavit of Mr. Leonard Curtis, who had charge of the United States Company in that case.

Mr. Curtis states that he first heard of Mr. Goebel in connection with incandescent lamps in the early part of 1882. He saw him then at his office in New York, and in answer to questions Goebel stated that he had made incandescent lamps like Mr. Edison's as early as about 1850. He thought that some one interested in the United States Company sent Goebel to him. He endeavored to go over the matter at considerable length but had much difficulty in understanding Goebel who spoke and understood English very imperfectly. He understood him to say that he had made lamps as early as 1850 and had operated them with a battery in his laboratory or shop in New York, and that a considerable number of people had seen them in operation. He was impressed at the time with Goebel's apparent truthfulness. He did not ask for any compensation for the information and did not seem to expect any advantage for himself from it. He did not gather from Mr. Goebel at any time the impression that he had made any use of the lamps except for experiments, nor that his work was continued for more than a year or so after 1850, nor did he succeed in getting track of witnesses to corroborate Goebel's statements. He was led to drop the matter at the time through his erroneous impression that Goebel's work had been entirely discontinued and abandoned within a year or two of 1850.

When the answer in the United States case was prepared he consulted with General Duncan about Goebel's statements and both concluded that it would not be worth while to put the Goebel matter in the answer or to look it up further, believing his work to have been abandoned in 1852 or thereabouts. He heard nothing further about Goebel's work until the closing of the proofs in the United States case. He then learned from J. Edgar Bull that the latter had seen one of Mr. Goebel's sons who corroborated his father's statements. He was also informed then for the first time that some of the original lamps might be in existence. He and General Duncan concluded, however, that the evidence then obtainable was not sufficient to warrant application to the Court to re-open the case, nor did he know at that time that any evidence existed for other or longer use of lamps than that before stated.

Mr. Curtis further states that the Goebel matter was again looked into in connection with the Sawyer-Man case, with some prospect of obtaining additional evidence; but counsel concluded that the time at their disposal on the injunction motion was too limited for looking the Goebel matter up. He did not know, nor so far as he was aware, did either of the counsel for the defendants in these prior cases, at any time during the progress of the litigation when the evidence could be availed of, that evidence of anything like the character and extent now presented in this case respecting Goebel's work was obtainable or existed. He had no hesitation in saying that counsel would have presented this evidence in the cases referred to if they had known of it in time.

Mr. Kenyon followed Mr. Witter and occupied the short interval left before adjourment at 4 p. m. The court arranged with counsel that the hearing should be concluded the next day.

Wednesday morning Mr. Kenyon resumed his argument. His address consisted largely of citations and quotations from documents in the previous suits on the Edison patent, and from the opinions of the courts in those cases, tending to establish mainly the proposition that in 1879 when Mr. Edison succeeded in making a commercial lamp, the state of the art as generally known included every requisite element save the filamentary carbon. He quoted at length from the opinon of Judge Wallace in the United States Co. suit, and from the decision of the Appellate Court. The evidence submitted in the present suit, said Mr. Kenyon, showed that the characteristic and necessary feature of the combination set forth in the second claim of Edison's patent, was anticipated many years by the use of Goebel.

Mr. Brandeis followed in further argument for the defendant, setting forth the irreparable injury to his clients that would follow an injunction, and their abundant financial responsibility for any damages that might be adjudged against them after a final hearing.

Mr. Seward then spoke for the complainants. He said a patent was a contract with the Government. The defendant did not deny infringement of the Edison patent as interpreted and adjudicated by the court of last resort, but set up an improbable and unconvincing story of prior use. A preliminary injunction should therefore be granted.

Mr. Fish made the closing argument for the complainants. A fundamental fact, he said, appeared clearly throughout the litigation of the Edison patent, and it would, he believed, control to the end. That was, that Mr. Edison gave to the world a new art. There had been no controversy as to that.

Until 1879 or 1880 it had been impossible to obtain an incandescent lamp by purchase, or to use one commercially. The United States intended that Mr. Edison should profit by his invention, but up to this day the patent had afforded absolutely no protection to him. Notwithstanding the judgments of the Court of Appeals in New York, upon the merits and equities involved, and the injunctions and restraining orders granted elsewhere, these defendants asked his Honor to stay his hand, saying that the New York decision was wrong. Mr. Fish then cited a large number of cases, quoting copiously from the language of the courts, tending to show that in analogous cases it had always been held that a prior invention or a prior use, to defeat a patent, must be proved beyond a reasonable doubt, and that considerations of probability would often outweigh a preponderance in number of witnesses and explicit statements made by them. In this case, he said, the defence say: "If your Honor is doubtful give us a chance to prove this thing before you grant an injunction." ~~We say~~: "Unless your Honor is sure, give us the injunction." The story was intrinsically more improbable than the Drawbaugh narrative in the telephone case. The production of 26 witnesses, at short notice, to the Goebel use on the public streets of New York over 30 years ago, and on from year to year, fairly means, that there were 26,000 who knew about it. The whole story could not be true. How much truth there was in it Mr. Fish did not know and the Court would probably never find out without a most extensive examination and cross-examination of witnesses. On the face of the affidavits he held that only the crudest and baldest kind of experimenting was shown, and no such use, in a commercial sense, as must be required to defeat a patent. Experiments might last 40 years as well as 40 minutes. Mr. Curtis's affidavit was entitled to the fullest credence of the Court, his distinguished ability and his entire integrity were well known to his brother lawyers.—Was it not exceedingly improbable that one so competent, managing the defence in the United States Company case—a sleuth-hound in ransacking every nook and cranny for evidence—should fail to get at all the facts in the Goebel story? After extended criticism of the affidavits and the exhibits of the defendants, Mr. Fish closed by asking that an injunction be granted, and admitting the seeming impropriety of asking the Court for special despatch, hoped his Honor would act with the greatest promptness consistent with the convenience of the Court.

The Court then announced that one week would be granted for printing the papers in the case and for the filing of briefs by counsel on both sides.

THE LATEST ELECTRIC LIGHT.

Mr. Henry Goebel gave an exhibition of his electric light last night in a room back of his store at 468 Grand street. Mr. Goebel claims that he has been at work on electric lights for 31 years and that 29 years ago, he arranged one on the top of his house at 271½ Monroe street. The light was seen from the Essex Market bell-tower and an alarm of fire was given, which brought out a number of engines. He himself was arrested, but Judge George Woods released him. When he had returned home he found that his neighbors had demolished all his instruments and apparatus. The light exhibited last night was clear and steady, and one could read by it with great comfort and ease. It is about 8 inches long and about as thick as a candle. The vacuum is obtained by a pump similar in principle to the Gessler (sic) pump and can be operated by unskilled hands. The carbon points used are made of reeds which are heated in the retort by electricity. The lamps cost 25 cent apiece and Mr. Goebel claims that he can furnish light as cheap if not cheaper than gas.—*New York World*, May 1, 1882.

MISCELLANEOUS.

THE PHYSIOLOGICAL AND OTHER EFFECTS OF HIGH FREQUENCY CURRENTS.

BY

Nikola Tesla

IN THE ELECTRICAL ENGINEER of January 25, 1893, I note an article by Mr. A. A. C. Swinton, referring to my experiments with high frequency currents. Mr. Swinton uses in these experiments the method of converting described by me in my paper before the American Institute of Electrical Engineers, in May, 1891, and published in THE ELECTRICAL ENGINEER of July 8, 1891, which has since been employed by a number of experimenters; but it has somewhat surprised me to observe that he makes use of an ordinary vibrating contact-breaker, whereas he could have employed the much simpler method of converting continuous currents into alternating currents of any frequency which was shown by me two years ago. This method does not involve the employment of any moving parts, and allows the experimenter to vary the frequency at will by simple adjustments. I had thought that most electricians were at present familiar with this mode of conversion which possesses many beautiful features.

The effects observed by Mr. Swinton are not new to me and they might have been anticipated by those who have carefully read what I have written on the subject. But I cannot agree with some of the views expressed by him.

First of all, in regard to the physiological effects. I have made a clear statement at the beginning of my published studies, and my continued experience with these currents has only further strengthened me in the opinion then expressed. I stated in my paper, before mentioned, that it is an undeniable fact that currents of very high frequency are less injurious than the low frequency currents, but I have also taken care to prevent the idea from gaining ground that these currents are absolutely harmless, as will be evident from the following quotation: "If received directly from a machine or from a secondary of low resistance, they (high frequency currents) produce more or less powerful effects, and may cause serious injury, especially when used in conjunction with condensers." This refers to currents of ordinary potential differences such as are used in general commercial practice.

As regards the currents of very high potential differences, which were employed in my experiments, I have never considered the current's *strength*, but the *energy* which the human body was capable of receiving without injury, and I have expressed this quite clearly on more than one occasion. For instance, I stated that "the higher the frequency the greater the amount of electrical energy which may be passed through the body without serious discomfort." And on another occasion when a high tension coil was short-circuited though the body of the experimenter I stated that the immunity was due to the fact that less *energy* was available externally to the coil when the experimenter's body joined the terminals. This is practically what Mr. Swinton expresses in another way; namely, by saying that with "high frequency currents it is possible to obtain effects with exceedingly small currents," etc.

In regard to the experiments with lamp filaments, I have, I believe, expressed myself with equal clearness. I have pointed out some phenomena of impedance which at that time (1891) were considered very striking, and I have also pointed out the great importance of the rarefied gas surrounding the filament when we have to deal with currents of such high frequency. The heating of the filament by a comparatively small current is not, as Mr. Swinton thinks, due to its impedance or increased ohmic resistance, but principally to the presence of rarefied gas in the bulb. Ample evidence of the truth of this can be obtained in very many experiments, and to cite them would be merely lengthening this communication unduly.

Likewise, observations made when the experimenter's body was included in the path of the discharge, are, in my opinion, not impedance, but capacity, phenomena. The spark between the hands is the shorter, the larger the surface of the body, and no spark whatever would be obtained if the surface of the body were sufficiently large.

I would here point out that one is apt to fall into the error of supposing that the spark which is produced between two points on a conductor, not very distant from each other, is due to the impedance of the conductor. This is certainly the case when the current is of considerable strength, as for instance when, like in the Faraday experiment or some of Dr. Lodge's, a heavily-charged battery of Leyden jars is discharged through a bent wire. But, when there is a vibration along a wire which is constantly maintained, and the current is inappreciable whereas the potential at the coil terminal is exceedingly high, then lateral dissipation comes into play prominently. There is then, owing to this dissipation, a rapid fall of potential along the wire and high potential differences may exist between points only a short distance apart. This is of course not to be confounded with those differences of potential observed between points when there are fixed waves with ventral and nodal points maintained on a conductor. The lateral dissipation, and not the skin effect, is, I think, the reason why so great an amount of energy may be passed into the body of a person without causing discomfort.

It always affords me great pleasure to note, that something which I have suggested is being employed for some instructive or practical purpose; but I may be pardoned for mentionting that other observations made by Mr. Swinton, and by other experimenters, have recently been brought forward as novel, and arrangements of apparatus which I have suggested have been used repeatedly by some who apparently are in complete ignorance of what I have done in this direction.

ELECTRICAL RECORDING METERS.—II.

BY CARYL D. HASKINS.

There is another device, or perhaps I had better say there might be another device for accomplishing the object of this last meter in a somewhat similar manner. The actinometer is probably familiar to all who have indulged in amateur photography; it consists of a piece of glass covered with small cubes, each cube of a more intense ruby red than the one beyond it, merging, in fact, from an almost clear glass to an almost perfectly non-actinic medium. Now, it suggestd itself to a certain electrician that if a number of these squares were arranged in a piece of glass, one above the other, and a lamp whose light should vary more or less directly with the potential on the lines, be placed before this glass or actinometer, a sensitive film being rotated behind the actinometer at a constant speed, that the varying light of the lamp would draw a curved line, or rather a curved block of light and shade on the paper, which would be measured by a planimeter to get the average voltage, or could be taken at points, to see what the voltage was at certain times; in fact, a recording voltmeter. This device seemed very nice indeed. It had only one fault—it would not work. I might say that the device is my own.

There is almost an endless variety of clock meters. They are not all electricity meters by any means; some are recording voltmeters, others recording ammeters, and others have still different purposes. The familiar recording steam gauge is only a modification of this instrument. A paper is almost invariably rotated over a drum, sometimes being fixed to the drum, and sometimes being drawn from one drum to another, the paper moving at uniform speed, and generally being divided into hours or other fractions of time by abscissæ lines.

This clock mechanism can be combined with any indicating device; it is only necessary to supply the connection which shall cause the indicator to mark the paper, and draw a crooked line. First attempts of this kind are generally made with an ordinary solenoid, or sometimes with a simple coil and iron core rising and falling with the current. Whatever the character of the indicator or method of communication between the indicator and paper, it remained necessary to keep the friction of contact low.

First attempts were made with a pencil, bearing directly upon the paper, but the friction introduced by this device was fatal to accuracy. A glass pen has been substituted for the pencil with better results, but even this caused too much friction. The photographic method of line drawing is one of the best systems yet introduced, and is probably more familiar to the majority of us than other methods, because it forms a component part of the Walker meter which has attracted attention at various times.

One of the best methods of accomplishing the registration, perhaps, when all things are considered, the very best, is to attach to the pointer of the indicator, a steel point or needle with an iron armature mounted in the form of a spring, or in some similar manner. By placing an electromagnet behind the paper to be marked, and sending through this magnet an electrical impulse at fixed periods of say, one, two or five minutes, the pointer is drawn sharply down to the paper, puncturing it, and is immediately released by the cessation of energizing current in the electromagnet. Thus, the paper when removed, will have a continuous marking of punctures tantamount to a curved line. This device presents practically no friction, and is more or less simple and easy to carry out. The make-and-break necessary for the electromagnet is easily actuated by the clock movements. But we may say of these forms, as well as of the forms of clock meter which are to follow, that there is one serious objection to them all—they have to be wound up, which is certainly a fault. We may modify this statement by saying that many of these devices have an electrical attachment which makes them self-winding, and this is a step in the right direction at least. Whether it fully meets commercial necessities, is, I believe, an open question.

All of these instruments being curve-drawing meters, they cannot properly be considered as the thoroughly commercial article, which the successful electric meter must be. For, I think I am safe in assuming that to be successful the meter of to-day positively must have a direct reading dial, equally available for the consumer and supplier.

This brings us to a second form of clock meter of a preferable character. This class comprises those meters whose clock mechanism is accelerated or retarded by the strength of the current passing through them. There are several methods of accomplishing this, all of which apply the influence of the current to the pendulum of the clock. For example, we have a pendulum with an iron end forming an armature which is attracted first to the right, and then to the left by two electromagnets dependent for their strength upon the lamp circuits. This is an early and very ineffective form of clock meter, hardly to be considered as a practical affair, but typical of the class.

The most successful and probably the best form of meter of this kind consists of two clocks with a differential gear between. One of these clocks runs at a constant speed, the speed of the other being governed by the circuit to be measured. At times by a shunt pressure coil forming an armature, and a fixed series coil forming a field, or again, by a horseshoe magnet pendant from the pendulum and vibrating back and forth above two coils in series with the lamps, the former being a watt-meter and the latter an ammeter. Both were designed by the same inventor. When nothing is passing through the meter, the speed of both clocks is the same, and the differential gear does not move; but when lamps are turned on, and the regulating device begins to act, one clock is accelerated or retarded according as the principle may be applied, and the difference between the constant speed clock and the varying speed clock indicates the consumption in directly read units.

I can safely say that this is an excellent meter, but is obviously open to the same objection as are other clock meters, since there are two clocks and the presence of the differential gear requires very nice adjustment between the two. There is another important factor here, which bears directly upon the question in hand, and that is, the cost of building meters of this class. The clock-work must not be of a cheap character, but must be good clock-work and good clock-work is invariably expensive, and is invariably delicate.

I might say, however, that the Aron meter, the typical meter of this type, proved itself so accurate at the recent meter competition in Paris, that it succeeded in dividing the first prize of 10,000 francs and a gold medal, with the Thomson recording watt-meter, the principle of which we shall consider later. Your attention may be directed to the fact that the Aron meter is a watt-hour indicator, something unusual, for almost everything considered up to the present point has been typically an ammeter or a modification of an ammeter.

Before turning to the final portion of this paper and considering the most popular and as yet the most successful class of recording instrument, viz., the motor meters, a little attention should be given to those clock meters, whose principle is dependent upon the function of a cone or cones. There are a considerable number of meters of this class. It appealed to the inventive mind early, and our patent records are full of cone meters.

Briefly, the principle of all of these instruments is about as follows:—Let us assume a wheel rotating at a constant speed; let us assume a cone mounted on a shaft on which it is free to rise and fall; let the cone rise and fall with one of its sides in a vertical plane with the periphery of a constantly rotating wheel; the speed of the cone regulates the speed of rotation of the recording gear and the position of the cone is determined by an indicator device which obviously must be of high torque, because friction must be a more or less serious factor. Some very fair instruments of this class have appeared from time to time. One of the most ingenious of them provides two cones, or rather two cone-like drums, somewhat like a beehive in shape. One of these cones is rotated at a constant speed, and the other is inclined on a movable right angle axis in such a way that its point of contact with the neighboring cone varies with the load. The same end is accomplished as that in the rising and falling cone just described without the introduction of as much friction. This is a type of the Maxim meter. Another similar device provides for a small wheel rising and falling between two cones whose inner sides are parallel, thus transferring the power from a constantly rotating cone, to a cone with varying speed, the same object and end being accomplished in all cases, and invariably involving friction.

Another form of cone meter, still a clock meter, differs somewhat from those just described. Let us assume a conical drum, shaped like the bullet of an ordinary rifle, and some four or six inches in diameter at the base, rotating at a constant speed by a clock mechanism beneath it; let us suppose a spool of thread to be placed upon a pin a foot or so removed from the drum; the thread from the spool is attached to the drum which should be covered by some felt-like material; the thread passes through an eye or ring which in its turn is attached to an indicating mechanism. It is apparent that the indicator will raise and lower the spring according to the amount of current or energy passing. Since the drum rotates at a regular speed, the thread will be wound onto the drum and the point where it is wound on will depend on the position of the indicator. Thus, if the load were very small, the indicator would be at its highest point and the thread would be wound around the smallest diameter of the drum. As the load increased, the indicator would be depressed and the thread would be wound on a greater diameter of the drum. The inspector of meters, on his monthly visit, would remove the thread which had been wound onto the drum, measure it on a yard stick, and ascertain perhaps that the consumer had used 15 yards of electricity. This is certainly reducing things to a very practical standpoint.

In conclusion, I would say of the clock meters, that those which actuate a drum or marking mechanism, and those akin to them, generally have a stopping and starting device which prevents the clock from running at times when there is no current passing through the meter; this is quite essential. Those which have a lamp within them for photographically marking the fluctuations of current, have an automatic cut-out for the lamp, which turns out the light in the meter when the last lamp on the supply circuit goes out. I might add that in a few of these meters the clock is displaced by a constant speed motor.

LUMINOUS DISCHARGES.[1]

BY E. C. RIMINGTON.

As the illumination of electrodeless vacuum tubes has been brought forward rather prominently during the past year, principally through the experiments of Tesla, the writer, in response to the request of the editor for a short article, thinks a few words on the subject may prove of general interest.

The cause of the illumination of an exhausted tube is a suddenly-acting electric stress in the dielectric, formed of the rarefied gas inside the tube; if the stress be great enough and applied with sufficient rapidity, the rarefied gas, being a weak dielectric, gives way, and a convection current passes in the tube. The luminosity produced is probably due to the molecules of the gas colliding with increased velocity, these collisions causing the molecules to vibrate in parts (somewhat analogously to the prongs of a tuning-fork), and to give out ether waves short enough to affect the retina of the eye; or it may be that the electric equilibrium of the molecules is upset by these collisions, and their charges caused to oscillate, thus giving out electromagnetic waves of short enough wave-length to be called "light." The effect just described may be produced in three ways.

1. By placing an exhausted tube in a rapidly-varying electric field. This is what happens when a vacuum tube is held near an influence machine which is sparking between its knobs, or in the vicinity of an induction coil whether the latter be sparking or not. If two metal or tinfoil plates about two feet square are suspended about eight or nine feet apart and connected to the terminals of a five and a half inch spark coil, a tube five feet long and about two inches in diameter will glow brilliantly when places anywhere between the plates.

2. By rotating a tube in a constant electric field, thus varying the electric induction through the tube. This effect was recently shown by the writer in conjunction with Mr. Wythe Smith before the Physical Society.

3. By rapidly varying the magnetic induction through the tube, which results in an electric stress at right angles to the magnetic induction. This can be done by wrapping a few turns, or even a single turn, of guttapercha-covered wire round the tube, and discharging a Leyden jar through this wire; a sharp and brilliant luminous discharge will be seen in the tube close to the wire. This discharge can be shown to possess all the magnetic properties of an electric current. The effect is in the main as described above, but is slightly complicated by electrostatic action, particularly in the case where the discharge is feeble, but space will not allow the writer to more than allude to this.

THE GREEN ELECTRIC RAILWAY PATENTS.

THE following dispatch from Springfield, O., of Jan. 29, is printed for what it is worth. The General Electric Company has confirmed it as we go to press, in its broad features:

> It is reported that O. S. Kelley of this city has sold his patent on the overhead electric trolley system to the General Electric Company of New York City. A friend of Mr. Kelley states that the rumor is true and Mr. Kelley has received a sum running up into the hundreds of thousands for his patent.
>
> A man named Green is the inventor of the patent held by Mr. Kelley. Green was poor, and Mr. Kelley furnished him funds for 20 years to prosecute his claims in the Patent Office at Washington. Two years ago the Supreme Court of the District of Columbia handed down a decision sustaining the validity of Green's invention, and Mr. Kelley bought him out. The patent covers all systems using the overhead trolley.

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[1] London *Electrical Engineer*.

LETTERS TO THE EDITOR.

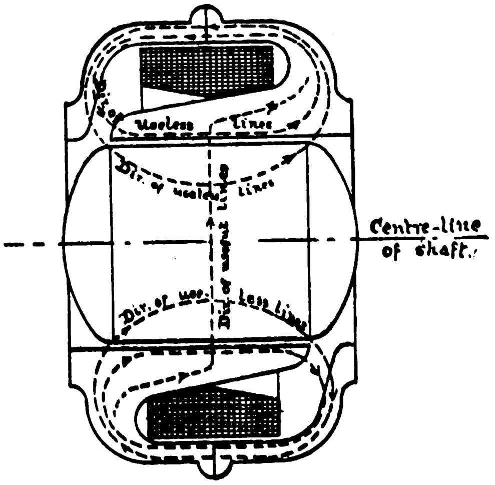
THE DESIGN OF THE LUNDELL MOTOR.

ALTHOUGH Mr. Lundell has taken recourse to personalities and insinuations, instead of reasoning, in his answer in THE ELECTRICAL ENGINEER of Jan. 11, 1893, I would like to point out some fallacies in his arguments and claims.

Mr. Lundell compares two well known types of motors, one shown in his Fig. 1, which may be called the Silvanus P. Thompson type, and the other in his Fig. 2, which may be called the Eickemeyer type, and shows the latter type to have a much longer wire per turn in the field coil; but he does *not* show what the more important gains are, which more than compensate for the increased length of wire per turn. Since the direct magnetizing of the armature and polepieces, which minimizes the leakage of lines of force in the field, is the only advantage the Eickemeyer type has over the Thompson type, I will, for the sake of argument, assume that said advantage really compensates for the increased length of wire per turn of the field coil.

Mr. Lundell further says, that the type under discussion (for some reasons *partially* shown in his Fig. 3), has about the same length of wire per turn as the Thompson type, but has been so "simplified and the resistance of the magnetic circuit made so small that the number of turns in the field coil are reduced to a minimum." But he *fails* to show in what respect it has been simplified or how the resistance of the magnetic circuit has been reduced, *more* than can be done in any other good type of motor.

In the description of the Lundell motor in THE ELECTRICAL ENGINEER of Dec. 7, 1892, Mr. Lundell says that "to a large extent the direct magnetization of the armature is also accomplished, so that a considerable economy in the ampere turns of the magnetizing coil is thereby effected;" and it may be inferred from this that Mr. Lundell claims the gain by direct magnetization of the armature also in the type under discussion to more than compensate for the increased length of wire per turn.



Referring to the accompanying figure, which shows more completely the type under discussion, every electrician will understand, that the direction of the lines of force due only to the direct magnetizing of the armature by the field coil would be *longitudinal* and *not crosswise*, as Mr. Lundell "seems to think," and as is the case in the Eickemeyer type, and that those lines would *tend* to leak into the field casting at the ends of the armature and will *increase* the resistance of the magnetic circuit by saturating it to a higher degree. No E. M. F. would be generated by the armature wire cutting *those lines*, since the same wire will cut them so that the E. M. F. generated at one end of the armature will be equal to, and of opposite sign to that generated at the other end. Thus the number of turns in the field coil of the type under discussion will be slightly *increased* by the direct magnetizing of the armature, and (using Mr. Lundell's statement of the comparative length of wire per turn) the watts necessarily spent in, and the cost of, the field coil must be at least 1.73 times that of the Thompson type. If the effect of the direct magnetizing of the armature were as great as Mr. Lundell claims, the increase in the watts spent in, and the cost of, the field coil, would be about two or three times that of the Thompson type, all other things being equal.

Mr. Lundell's opinion of the Thompson type does not seem to be shared by such eminent electricians and firms as Mr. Wood of The Fort Wayne Electric Company, Jenney Electric Motor Company, the United States Electric Lighting Company, and others, who have lately adopted the Thompson type.

I will further add that I did not *have to* abandon the type under discussion, but could have kept on building it, had I desired to, since the buyers of motors in general neither have the knowledge, time nor facilities for finding out if the type offered them is the best or not. The motor claimed by Mr. Lundell and built by me in 1888 was in public use and, so far as I know, is so yet. Proofs of my priority will be furnished, when needed.

OLOF DAHL.

NEW YORK CITY, Jan. 18, 1893.

COMPOUND WOUND MACHINES.—A LITTLE MORE LIGHT WANTED.

First I will thank Mr. J. F. Denison for his kind letter in THE ELECTRICAL ENGINEER, Vol. xv., No. 244, p. 20, and beg to say that my query in THE ELECTRICAL ENGINEER, xiv., No. 242, p. 606 was intended to elicit, not to shed, light on the subject, and, if possible, to draw into print information which, passed by the few, is yet of interest to all students of electrical engineering.

In practice a generator is needed which will maintain (*i. e.*, will not lower) its E. M. F. under load-increase from zero to that maximum for which the machine was designed. The exact *value* of this E. M. F., in volts, is fixed when the dynamo is built at, say, 110, 220 or 500. Besides this, it is also sometimes useful to have a machine in which we can change the *value* of the E. M. F. while still the machine will, by its compounding, maintain that E. M. F. constant whether the new particular value be made 110, 115 or 120 volts.

One way to change the E. M. F. value is to make the last few turns of the top layer of the shunt field circuit of German silver wire and to use a suitable contact to cut a number of these turns out of circuit when the E. M. F. is to be raised, say, from 110 to 115 volts. This was the method employed in isolated lighting Thomson-Houston incandescent dynamos, which were *also furnished with* the German silver flute as a series coil shunt. Other makers simply use a rheostat in series with the shunt field circuit.

The over compounded machine is designed to raise the *value* of the E. M. F. as the load increases up to a fixed maximum coincident with the maximum current which the armature can carry without dangerous heating.

If the maker places a shunt in his series coil *provided with* means of variation and issues a diagram of the various relative resistance values of this shunt, I may (*pace* Mr. Denison) have rightly assumed that he intended the said shunt to have some effect on the operation of the machine. That its removal was without any measurable effect on the working of the machine under any conditions, may show Mr. Denison that the machine was well designed although he certainly fails to show why, in this event, the variable shunt was placed on it.

In commercial manufacture a lot of machines built to the same specifications will on test perhaps compound well enough, but will have a variation in their respective E. M. F. values of 1¼ to 2 per cent. In some factories these are all corrected to give the one intended E. M. F. by means of adding to each a German silver or other resistance in shunt to the series coil; and these are what Mr. Denison calls "standard machines" as opposed to "variable shunt" (to series coil) machines.

It may be noted that in general, no machines are used without a rheostat in the shunt field circuit by which the E. M. F. is adjusted. This being so, it seems hardly necessary to use the series coil shunt to correct a variation that no ordinary consumer would be likely to think of, much less discover, without the aid of trained assistance.

Reference might be made to a possible slight alteration of compounding due to shifting the working range slightly along the characteristic through the use of the rheostat, but that question need not now be considered.

The question of the utility of the series coil shunt, whether fixed or variable, is still open to discussion. Shall it be regarded as a valuable commercial appendage to the generator or merely as an advertising refinement? Let us have more light.

J. STANFORD BROWN.

NEW YORK, Jan. 20, 1893.

TWO QUERIES.

I beg to be allowed to seek through the medium of your valuable journal information on the following points:

1. I have to separate several layers of thin iron sheets adhering to each other by the pressure of the air and which probably also "stick" together a trifle. There are eight sheets in each bundle. As it takes such a long time to separate them by means of a knife, I would like to know if some electromagnetic apparatus could not be devised to do this work quickly?

2. Can I make the varying pressure, between two discs constituting a microphone, visible by the aid of some electric device?

NEW YORK, Jan. 11, 1893. G. S. F.

THE USE OF ACCUMULATORS IN FRANCE.

I HAVE read with interest the various articles in your journal on the reason accumulators are not generally used in the United States, but I do not think any of the writers have touched on the real reason, viz., that all accumulators are sold here with the guarantee that during 10 years the cost of keeping them in order shall not exceed an average of 10 per cent. per annum ; so that the buyer can figure out in advance just what the item of repairs will come to. This figure of 10 per cent. per annum is for accumulators used for lighting, but even those used on the tramway are renewed by the accumulator company on a basis of so much per mile. The accumulator companies in the United States are very profuse in assertions as to the low cost of repairs and renewals, but show their want of faith by refusing to guarantee their assertions. I have recently visited the works of the Paris Company, which is running 25 storage battery cars, and found the cars running very satisfactorily from the point of view of the Tramway Company ; and the accumulator company which supplies and keeps in order the batteries states it is making money on the contract. Add to this that the public are very much in favor of this kind of traction, and it appears that everybody is pleased. N. W. BARTOL.

PARIS, FRANCE, Dec. 23, 1892.

FIXED CLOSED COILS IN ALTERNATING MOTORS.

THE number of *La Lumière Électrique* for Dec. 24, 1892, which has just reached us, contains an article by F. Gilbert on a method, attributed to MM. Hutin and Leblanc, of constructing alternating current motors and dynamos so as to improve their efficiency, output and regulation. The method consists in short in disposing about the armature fixed closed circuits. We desire to state that this arrangement is the subject of a patent application of ours now pending. As your readers may remember, we have already patented the use of fixed closed coils parallel to the magnetization of the field (U. S. patent, No. 479,675). The present arrangement consists in the combination of such coils with others transverse to the field magnetization. The combination of the two sets serves to neutralize the self-induction of the armature and to lessen the reaction on the field due to the varying reluctance and M. M. F. of the armature.

We do not wish in any way to question MM. Hutin and Leblanc's originality in this matter, although the most important part of the combination was described long ago by us. We are even prepared to read in the columns of their organ, conducted by the virtuous Dr. Cornelius Herz, that this is another signal instance of American copying of European work.

W. STANLEY, JR.
JOHN F. KELLY.

THE STANLEY LABORATORY COMPANY,
Pittsfield, Mass., U. S. A. Jan. 24, 1893.

PERSONAL.

HONORS TO NIKOLA TESLA.

DURING Mr. Nikola Tesla's sojourn abroad last year, a special deputation of prominent scientific men of Servia was sent to Budapest by the Servian Government to escort him to Belgrade, where the young King Alexander I., of Servia, granted him a special audience and evinced great interest in the work in which Mr. Tesla is engaged. In recognition of his merit, King Alexander has just created Mr. Tesla a Grand Officer of the Order of St. Sava. The insignia of the Order have just been transmitted to Mr. Tesla from Belgrade.

MR. E. CALDWELL, associate editor of *The Electrical World*, and during the last eighteen months in charge of the editorial department of that paper, has resigned his position, and will hereafter have no connection whatever with the concern. Mr. Caldwell writes us that he goes to Chicago to become editor of the *Street Railway Gazette*, in which, with some friends, he has secured a controling interest. He is an old electric railway man, a clever writer, a conscientious worker and one whom everybody will wish abundant success. We do, with all our heart.

MR. CHAS. P. BRUCH, formerly secretary of the T. M. B. A., later of the Empire City Electric Company, and more recently connected with the Postal Telegraph-Cable Company has now been appointed assistant secretary of that company, with his office at the headquarters, 1 Broadway. Mr. Bruch's steady rise is watched with much pleasure by a host of old friends.

ANOTHER SOUTH AMERICAN CABLE.

THE CENTRAL AND SOUTH AMERICAN TELEGRAPH COMPANY has authorized an increase of its capital from $6,500,000 to $8,000,000 for the purpose of duplicating its cable lines on the west coast of Central and South America. The new line is to go from Santa Cruz, Mexico, to Chorillos, Peru, and will be completed about May 1.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JANUARY 17, 1893.

Accumulators:—

Secondary Battery, H. H. Lloyd, Philadelphia, Pa., 490,254. Filed Aug. 30, 1892.

Comprises a perforated conducting support having pieces of active material supported in the perforations; separators between the supports and a woven fabric disposed between the separators and the faces of the positive plate.

Alarms and Signals :—

Electric Alarm Lock, J. A. Nadeau, Detroit, Mich., 490,161. Filed Sept. 2, 1892.

Dynamos and Motors :—

Commutator Brush and Holder, J. F. McLaughlin, Philadelphia, Pa., 490,081. Filed Mar. 31, 1890.

Invention consists of one or more blocks of conducting material hinged to a shank which moves in the line of a radius of the commutator cylinder, against which the brush is yieldingly held.

Commutator Brush, C. O. Billberg, Philadelphia, Pa., 490,183. Filed Sept. 20, 1890.

Consists of copper or equivalent metal on the entering edge with a backing of carbon or similar material on the leaving edge.

Galvanic and Thermo-Electric Batteries:—

Electric Battery, J. H. Davis, Detroit, Mich., 489,938. Filed Mar. 28, 1892.

Claim 1 follows :

In a primary battery the combination of a carbon element, a zinc element, and an insulator interposed between the two constructed of soft rubber and having grooves in the periphery thereof.

Galvanic Battery, N. M. Powell, Galesburg, Ill., 490,231. Filed Dec. 19, 1891.

Has for its object to provide means for automatically supplying water to the cell when necessary.

Heating :—

Electric Heater, T. E. Morford, Minneapolis, Minn., 490,034. Filed Dec. 19, 1890.

Employs a heated surface plate and a coating of enamel in which the resistance is embedded, and by which it is insulated from the plate.

Electric Heater, J. F. McLaughlin, Philadelphia, Pa., 490,082. Filed Apr. 28, 1892.

Claim 1 follows :

An electric heater composed of a conductor of high electrical resistance embedded in a mass of fire proof material coated with glazing or enamel.

Electrically Heated Soldering Iron, G. R. Meitzler, Cincinnati, O., 490,256. Filed Mar. 31, 1892.

Miscellaneous :—

Electric Telemeter Transmitter, F. J. Dibble, 490,012, Peabody, Mass. Filed Nov. 21, 1891.

Has for its object to record not only the speed but the direction of movement of a rotating shaft.

Electric Telemeter Transmitter, F. J. Dibble, 490,013, Peabody, Mass. Filed Nov. 21, 1891.

A system which may be operated over a single line circuit employing a single line battery or generator.

Electric Telemeter System, F. J. Dibble, 409,014, Peabody, Mass. Filed May 12, 1892.

Similar in its object to 490,012.

Mechanism for Testing Watch Balances and Hair Springs, G. E. Hunter, Elgin, Ill., 490,202. Filed July 2, 1892.

Method of Testing Watch Balances and Hair Springs, G. E. Hunter, Elgin, Ill., 490,203. Filed July 2, 1892.

Automatic Releasing Device, H. P. Nielsen, Alameda Cal., 490,211. Filed Sept. 14, 1892.

A device for electrically releasing hitched animals, such as fire engine horses, etc.

Railways and Appliances :—

Electric Car Brake, A. C. Miller, Auburn, N. Y., 489,972. Filed Nov. 30, 1891.

Trolley, J. C. Love, Chicago, Ill., 490,028. Filed May 17, 1892.

Employs two trolleys and two independently yielding spring supported arms on which they are mounted, the arms being pivoted to the free end of the main arm.

Electric Railway System, T. Harris, Detroit, Mich., 490,248 Filed Dec. 28, 1891.

A system employing sectional underground conductors successively rendered active as the car passes over them.

Switches and Cut-Outs :—

Electric Railway Switch, A. C. Goetz, Milwaukee, Wis., 489,944. Filed Sept. 27, 1892.

A railway track having a branch track and a movable switch point; two sets of insulated sections of the rails on the same side of the switch point but at a greater and a less distance therefrom respectively, helices connected to a set of the insulated sections of the track and a device connected to the switch point adapted to be reciprocated by the energizing of one or the other of the helices, and by its reciprocation to shift the switch.

Electric Cut-Out, W. B Potter, Lynn, Mass., 489,983. Filed July 5, 1892.

A fuse box having a chamber with an opening through the wall of the box, a magnet adjacent to said chamber, and a safety fuse in the chamber between the magnet and the opening.

Electric Circuit Breaker, E. Thomson, Swampscott, Mass., 490,178. Filed Oct 28, 1892.

Claim 1 follows :

The combination of a multiple contact-circuit breaker with self inductive coils arranged to preserve a proper distribution of the current between the different paths provided for it. (See page 107 this issue).

Telephones and Apparatus :—

Telephone, C E. Scribner, Chicago, Ill., 489,990. Filed June 1, 1888.

Claim 1, follows :

A carbon telephone transmitter disc electrode provided with inclined concentric rings forming deflecting surfaces.

Electric Meter, F. J. Dibble, Peabody, Mass, 490,011. Filed Nov. 21, 1891.

Has for its object to provide means whereby irregular movements of the contact arm shall be made to transmit a regular and uniform movement to the indicating device.

Telegraphy and Telephony, F. H. Brown, Chicago, Ill., 490,064. Filed Feb. 27, 1891.

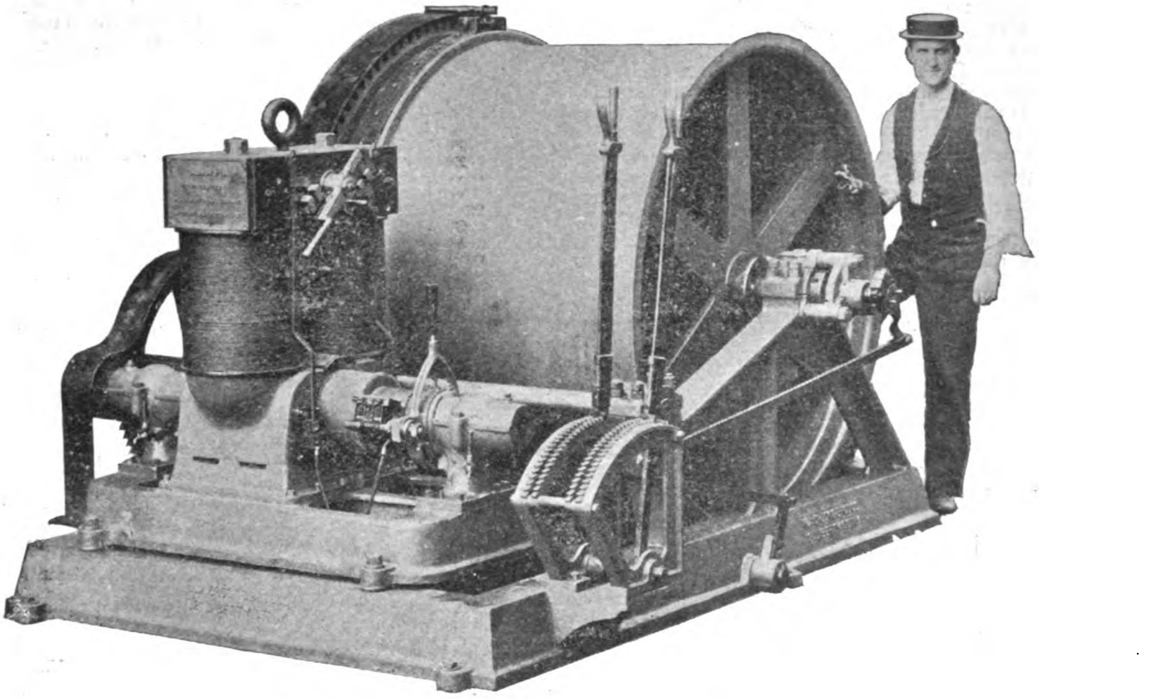
An instrument which may be used either as a telegraph or a telephone and will operate as a telephone on a telegraph circuit.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW GENERAL ELECTRIC MINING HOIST.

A NEW electrical mining hoist has been recently brought out by the General Electric Company. It is constructed with the especial object of obtaining a wide range of hoisting speed, to which end the controlling apparatus has been carefully perfected. The drum is of unusually large diameter and is connected by an intermediate gear to the armature shaft of a 25 kilo watt, (30 h. p.) motor of the General Electric Company's regular bi-polar type. The controller for the motor is similar to that used in street railway service, and is erected on a separate support conveniently within reach of the operator and directly to the right of the levers. These can then be operated with the left hand, and the controlling switch with the right. The series method of electrical control is adopted, the speed being increased or decreased to meet requirements, by the movement of the switch handle. The hand brake is of the band type, lined with wood, and extends almost entirely round the drum. The drum is thrown into operation by a clutch operated by the second lever.



New General Electric Mining Hoist.

The range of speed obtained on this hoist is very wide. It is designed to raise loads of 1,300 lbs. at a rate of 600 feet a minute, and has successfully accomplished this. It can also raise loads of 100 lbs. at a speed not exceeding 20 to 30 feet a minute. The motor is erected on its own bed-plate bolted to the bed-plate of the hoist proper, the whole apparatus occupying comparatively little space owing to its compact construction.

"THE MINERAL INDUSTRY."

"THE Mineral Industry, Its Statistics, Technology and Trade in the United States and Other Countries, From the Earliest Times to the Close of 1892," is the annual statistical supplement of the *Engineering and Mining Journal.*

The great work of collecting and publishing in the *Engineering and Mining Journal*, within a few days of the close of each year, reliable statistics of the mineral industry of the United States and other countries, whose products are valued at far more than $2,000,000,000, has become so important that a large octavo volume will be issued shortly covering them, and will be, it is said, the most complete and valuable report of mineral statistics ever published.

It will treat each of the various subjects in the following general order: Describing the occurrence and character of deposits in which the minerals are found; the characteristics of the mineral methods of treatment; cost of mining; characteristics of metal or other products; costs; uses; statistics of production; imports and exports from the earliest times; consumption, total and per capita; review of markets; prices; foreign production; imports, export and consumption; extremely valuable technical articles by the most competent authorities, giving the recent progress in each department of mining and metallurgy. Diagrams will illustrate each important feature of this industry. The tables of itemized cost of production of many of the minerals and metals will afford information of the utmost value. The progress in the chemical industry will be given in expert reports covering the industry to the close of the present year in Europe and America.

THE STERN INCANDESCENT LAMP.

IT is reported that a big factory is to be started at Buffalo, N. Y., to manufacture the incandescent lamp invented by Mr. Philip K. Stern, of that city, and that the initial capacity is to be 25,000 lamps a day. The factory is to cost $250,000. "In the Stern electric lamp the filament is embedded in solid glass. The loop is of pure and solid glass, and in the middle of the glass is the filament firmly embedded. There is therefore no loss of substance, for though the carbon particles may vibrate, yet no particle can be lost. There it is in the glass. There it must stay, and no matter how long the electric current vibrates through it, it will retain its substance and pour forth light. There is no vacuum in the lamp. Air will be rather pumped in than out, to prevent the expansion of the glass when it is heated. Air will be used to prevent expansion of the glass and thus there is no confliction with Edison's patents in the matter of a vacuum. Stern's lamp is unique. It is a marvelous light giver and when once put up it is there to stay. It will not burst like ordinary electric lamps when struck and throw fragments of glass in one's face."

WILSON & JACKSON.

THIS firm has been formed by C. H. Wilson and George W. Jackson, with headquarters in the Times Building, Chicago. Mr. Wilson is well-known from his long and active connection with the telephone system in Chicago. The firm will devote itself to the construction of underground and aerial plants for electrical companies.

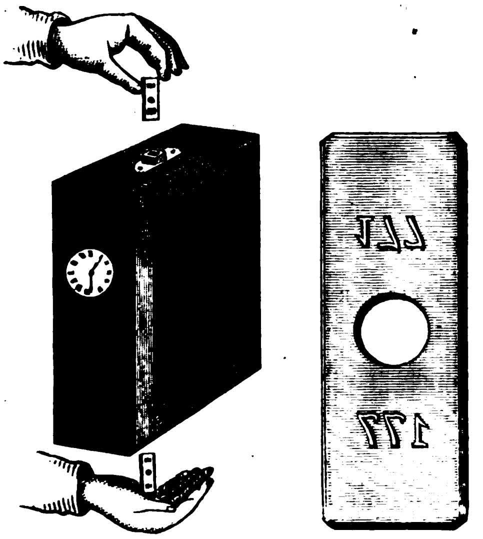
NEW YORK NOTES.

MESSRS. W. S. CHESLEY & CO. who have recently opened a well equipped repair shop at 24 Morris street, Jersey City, are also doing an extensive business in buying and selling all kinds of electric light and power apparatus. Although they deal largely in second-hand material, they believe in using nothing but the newest and the latest designs of machinery in their factory. Mr. Chesley has had a long experience in electrical work, and deserves support.

ENGLISH'S WORKMAN'S TIME RECORDER.

THE accompanying illustrations show an ingenious automatic time recorder, invented by Mr. J. C. English and introduced by the Columbian Time Recorder Company, of 82 Frankfort street, New York City.

The mechanism is inclosed in a polished oak case, 17 inches high, 14½ wide and 7 deep, shown in Fig. 1, in the top of which is a slot for the reception of checks carried by the workmen and having raised numbers by which the men are known. Fig. 2 shows one of these checks full size. The employé in passing the recorder drops his check into the slot at the top of the box and receives it in the other hand from the bottom. Checks can be recorded in this manner, one workman following another in succession, at the rate of 50 or more a minute, or they can be passed through the recorder by a single individual at the rate of 125 a minute, the machine recording each check in a perfect manner. The results of the recording are shown in Fig. 3, which is a reproduction of a portion of the printed record, as made by six workmen passing their checks through the machine. It will be seen that these men passed the recorder between five and eight minutes past 6 o'clock.



TIME H.	TIME M.	WORKMEN'S NOS.
6	6 5	22
6	6 5	32
6	7 6	14
6	7 6	40
6	8 7	12
6	8 7	19

FIGS. 1, 2 AND 3.—ENGLISH'S WORKMAN'S TIME RECORDER.

The interior construction of the recorder consists of a train of gears, operating a hammer; a stop for the check, hour and minute wheels operated by an eight-day double-spring Seth Thomas movement; an inked ribbon and a reel for carrying the roll of recording paper. The check upon entering the slot is guided in its course downward by runways until it strikes an arm, which stops the check, holding it until it is recorded by a blow from the hammer, and at the same time closes the slot, so that but one check can be put into the slot at a time. The blow from the hammer releases the check, allowing it to drop out of the case, and also opens the slot for the reception of another check. The various operations which are gone through during the passage of the check from the time it enters until it leaves the case are very simple, and only occupy a second of time or less.

RAILWAY EQUIPMENT COMPANY.

THE annual meeting of the stockholders of the Railway Equipment Company, Chicago, was held on Tuesday, 17 ult., and the report of General Manager W. R. Mason showed a most satisfactory state of affairs. The business of the company has been very greatly in excess of expectations and is daily increasing. The late devices brought out by the company have had an unprecedented sale and are being adopted throughout the entire country. Mr. Mason called attention to the need of further increasing the manufacturing facilities. We understand that a very prominent capitalist has become interested in the company with the intention of still further increasing its business.

ANNUAL REPORT OF THE NEW YORK EDISON COMPANY.

The annual meeting of the Edison Electric Illuminating Company last week resulted in the re-election of the old board of directors. The report shows gross earnings, $942.575; expenses, $385,494; net, $557,080; income from other sources. $20,446; net income, $577,527; other expenses and taxes, $102,889; balance for interest and dividends, $375,187.

In 1889 net earnings were $124,031, against $435,177 in 1892. The number of customers has increased from 1,218 in 1889 to 4,344 in 1892; net earnings increased 86 per cent. in 1892 over 1891.

The financial plan provides for the increase of the capital stock to $6,500,000 and of the first mortgage bonds to $3.250,000. The Manhattan Company and the Harlem Lighting Company have been brought into harmonious relations with the Edison Company, through the Edison Light and Power Installation Company. The work of the company in 1893 will be much less costly than it has been during the three previous years.

NEW ENGLAND NOTES

COLONEL R. C. EDEN, who has for some time past been assistant manager of the Brookline Gas Company, was presented a few days ago, on the occasion of his resignation, as a token of their appreciation of his efforts, by a number of his fellow employees, with a handsome gold-headed cane with inscription, a silver mounted umbrella, silver mounted pipe, a box of cigars and a few other articles calculated to cheer him on his release from his arduous duties. Col. Eden has become well known to a large number of electrical men in the vicinity of Boston, and has endeared himself to many by his straightforward and manly qualities., and thorough practical knowledge of his work, and the Brookline Gas Company lose the services of one whose position it will be difficult to fill, and one who was always ready to undertake the hardest duties for the interests of the company he was working for. He has the heartfelt good wishes of a large number of warm friends, who wish him well in his new field of labors.

THE EASTERN ELECTRIC CABLE COMPANY, of Boston, have recently declared another of their regular semi-annual dividends of 8 per cent. on the preferred stock. Mr. Henry A. Clark, the treasurer of the company, reports that the business for December of the past year, was 50 per. cent. in excess of what it was for the same month in the preceding year, and that he is constantly making additions to his factory to accommodate their rapidly-increasing business. The Clark wire grows more popular year by year, owing to its unvarying uniformity and excellent insulating qualities. The Eastern Electric Company have now one of the largest and best equipped factories in the East for the manufacture of high grade wires and cables, and they are now making large additions and installing some very heavy machinery for the manufacture of the very heaviest types of telegraph, telephone and electric light and railway cables.

THE MASSACHUSETTS ELECTRICAL ENGINEERING COMPANY, of Boston, have recently closed a contract by which they will design and have charge of the construction of a model central lighting station at Oconomowoc, Wis., with a capacity of about 3,000 incandescent lights and 80 arc lights. The station will be situated in the residence portion of the city, and will be built of Milwaukee brick, and everything done to make it handsome and in keeping with its surroundings. The Massachusetts Company have also charge of the new station of the Rumford Falls Light and Water Company at Rumford Falls, Me. The station will be built for incandescent and arc lighting, and power circuits, and will also probably be heated by electricity. It will be operated by turbines, the surplus power being used for heat.

SWAN AND LANE, of Boston, have just completed the wiring of the Taunton Opera House, at Taunton, Mass., where they have installed about 700 incandescent lights. They have installed a very simple and effective switchboard and stage regulators and have introduced a number of original ideas in the way of controlling the lights and producing novel stage effects. They have a large quantity of other work on hand, most of it being done without any contract prices, but simply on a cost basis, so that the best of electrical work can be put in, without regard to keen competition prices.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., have received the contract for rebuilding the Tube Mill of Curtis & Co., at Cohoes, N. Y., lately destroyed by fire. The new plant will be fire-proof, constructed entirely of iron and brick, no wood-work being used. The building will be 132 feet wide by 131 feet long, with a wing on one side 20 feet wide by 74 feet long.

THE NEW ENGLAND ENGINEERING COMPANY, of 180 Summer street, Boston. will be the new name of the Electric Railway Engineering Company, as it has been recently re-organized. Mr. J. F. McGowan will continue as manager, and Mr. A. W. Jaastad as chief engineer.

THE BROCKTON STREET RAILWAY COMPANY of Brockton, Mass., have ordered a new 500 h. p. Erie Ball cross-compound engine, and multipolar generators of a similar capacity.

"RIGHT UP TO DATE."

A PHILADELPHIA reader writes us: "Being interested in this science only in my desire to know 'what is going on,' I hav found the ENGINEER to be a first-class medium for keeping me posted 'right up to date.'"

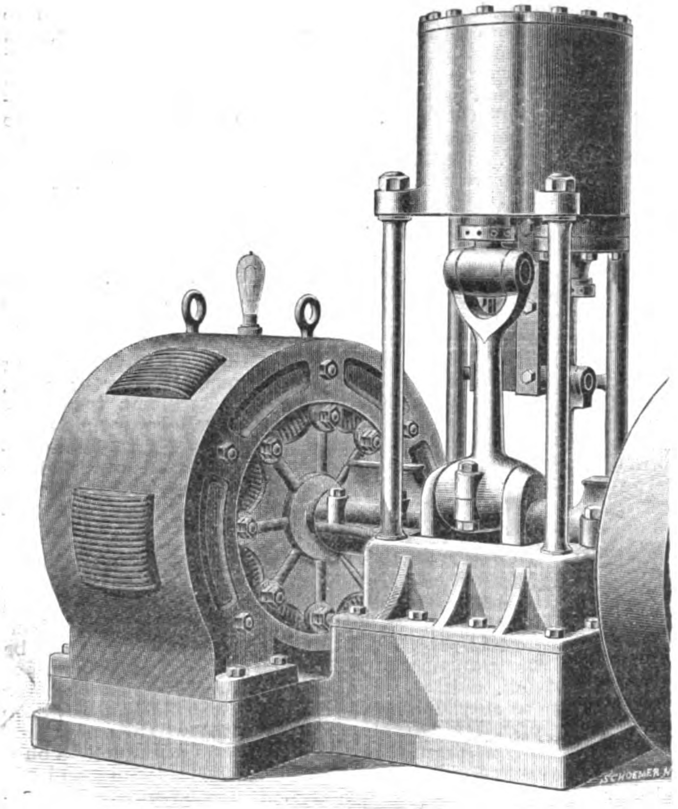
THE RIKER MULTIPOLAR MARINE DYNAMO AND ENGINE.

The accompanying illustration shows a direct connected engine and dynamo designed especially for yachts by the Riker Electric Motor Co., of 45 and 47 York street, Brooklyn.

For 100 lights and upward, the armature is attached directly to the engine shaft. The engines are light and the dynamos are of low speed. The combination is a marvel of compactness and lightness, showing very high efficiency, weight, speed and dimensions being considered.

These plants are designed for a minimum steam pressure of 80 pounds. The largest, built for 225 lights, occupies a deck space of only 10 square feet—5 x 2—has an extreme height of 56 inches, and weighs 1,525 pounds.

The catalogue for 1893, issued by the company, is a very attractive little pamphlet, illustrating and describing a quantity of interesting Riker apparatus, and containing, beside, some excellent half tone reproductions of yachts that are well worth framing.


SCHOENER N.Y.

Riker Multipolar Marine Dynamo and Engine.

A NEW FACTORY FOR THE AMERICAN ELECTRICAL WORKS

The American Electrical Works have recently purchased from Charles Fletcher, the Richmond Paper Co.'s Mills in East Providence. This property originally cost the Paper Co. $1,000,000, and was sold January 11, at auction, to Mr. Charles Fletcher for $42,000. The American Electrical Works paid something of an advance on this, but consider they have acquired a large amount of mill property at a remarkably low price.

The plant consists of about 28 acres of land, three miles from the city of Providence, upon the Seekonk River, and upon the Providence & Worcester R. R., affording excellent water and railroad communication.

The buildings are mainly of brick, and of the following dimensions: One building 160 x 65, four stories; one building 200 x 50, one story with attic; two buildings 150 x 60, one story; one building 200 x 30, one story; one building 200 x 40, one story; one building 130 x 60, one story.

The one story buildings are constructed with walls suitable for an additional story. There are also an engine house, boiler house, water filter beds and a large boarding house and several tenements.

The steam plant consists of two Greene improved engines of 600 h. p. each, and 14 six feet horizontal tubular boilers, in good order. The water supply is abundant, and of the purest quality. The plant will be used for the extension of the business of the American Electrical Works.

WESTERN NOTES.

The Electric Appliance Company are just receiving the first large shipment of their new lamp sockets to be known as the Acme. While the socket has no peculiarly startling features, it has a number of small improvements over others in the market in small details, such as an increased amount of room for the wiring cord; extra long contact screws for securing the cord; and a heavy and handsome shell. In fact it is a splendidly made socket in every way. The Electric Appliance Company are putting in a very large stock in anticipation of heavy demand which will no doubt be realized.

Mr. S. W. Hume, so well known to the engine and machinery trades through his long connection with *Power*, has decided to become a resident of the World's Fair City, and will hereafter represent as Western Manager, *Power*, and the new journal, *Heating and Ventilation*.

A Neat Order.—George Cutter reports an order from the Chicago City Railway Co. for 14 miles of Simplex waterproof wire of 500,000 circular mils. This is made with 76 strands of Number 12 wire, over 1,000 miles of this size being needed for the purpose.

Mr. G. W. Russell, of Russell & Officer, Denver, Col., was in Chicago last week and reports a large demand for their automatic switch.

NEW YORK NOTES.

Frank R. Chinnock, 18 Cortlandt street, New York, Eastern agent of the Ball Engine Company, of Erie, Pa., reports large sales of this well-known engine throughout his territory. The following are among the recent orders he has filled: Buffalo, North Main and Tonawanda Street Railway Company, Tonawanda, N. Y.; Ithaca Street Railway Company, Ithaca, N. Y.; Seabury & Johnson, East Orange, N. J.; Hahne & Co., Newark, N. J.; Dow's Stores, Brooklyn, N. Y. The Ball Engine Company recently issued a handsome descriptive catalogue, and Mr. Chinnock would be glad to furnish it to any one desiring information on automatic high-speed engines for electrical purposes.

The Goubert Manufacturing Company, located at 32 Cortlandt street, New York City, makers of the Goubert Feed-Water Heater, have purchased the patents, stock and business of the Stratton Separator Company, and are now the sole manufacturers of the well-known Stratton Separator. This device for extracting entrained water and grease from steam, that it may be furnished dry to engine, is one of the most popular inventions of the kind on the market, and its manufacturers have enjoyed a substantial increase of business yearly.

The Crocker-Wheeler Electric Company, New York, are at work upon a new catalogue, which they will shortly issue for gratuitous distribution. The work will be finely illustrated and replete with information regarding the company's well-known and extensive line of dynamos, direct-current transformers, fan motors, etc.

Mr. H. W. Weller, of the New York Office of the Railway Department of the General Electric Company, has been in charge of their Railway Supply House, 24 West street, in New York, since Dec. 1st last. Since he has had this department under his care, the results obtained have been more than satisfactory.

The Shaver Corporation. Mr. G. F. Shaver, president of the above corporation, of No. 1 Broadway, which controls the Shaver and other telephone patents, reports, in reply to inquiries, that the company has a registered capital of $2,000,000 in $100 shares, now quoted at $75.

BALTIMORE NOTES.

The Automatic Switch Company have changed offices from No. 8 Keyser Building, to 703 and 705 Equitable Building, Baltimore city. The Equitable Building has just been completed and is one of the finest office buildings in this country. They will be happy to see their friends in these new offices.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XV. FEBRUARY 8, 1893. No. 249.

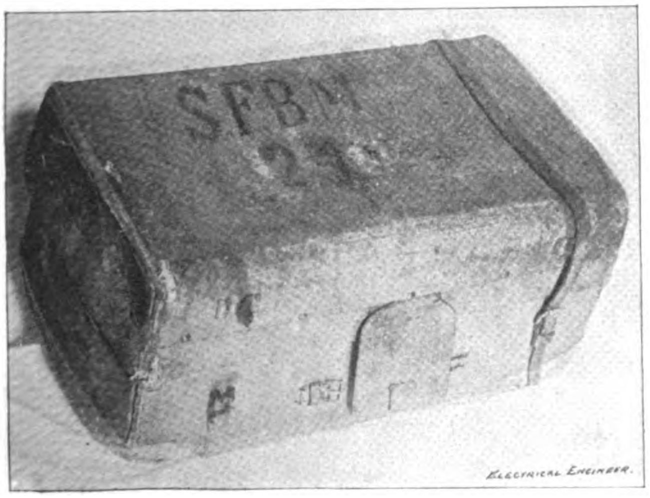
WILLIAM WALLACE, AND HIS CONTRIBUTIONS TO THE ELECTRICAL INDUSTRIES.[1]—II.

BY

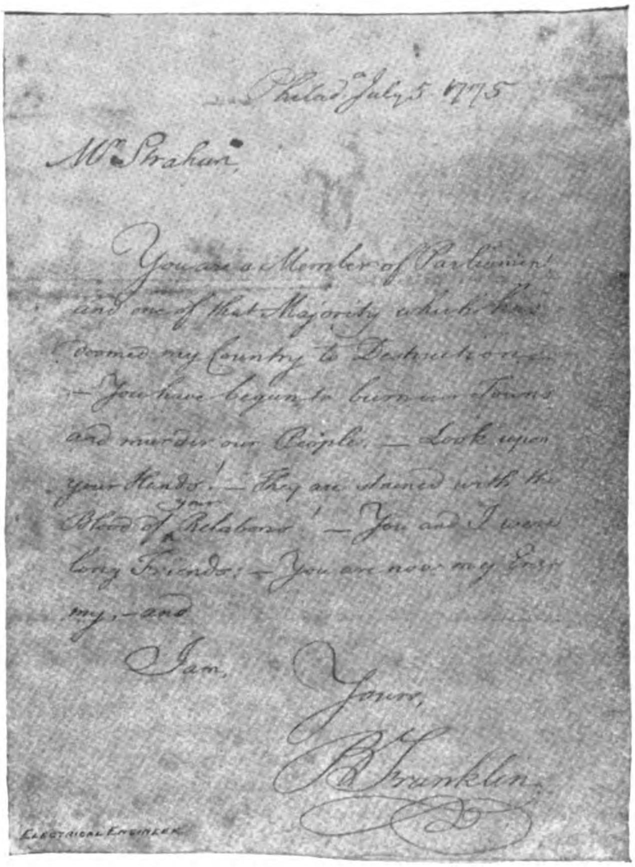
Wm. J. Hammer

IV.

MR. WALLACE was one of the little band of scientific men who assembled on that memorable Sunday afternoon in July, 1876, at the Centennial Exhibition at Philadelphia, to witness the first public exhibition of the Bell telephone. At that time Prof. Barker, representing the Exhibition authorities, was wont to gather together a coterie of men eminent in science and the industrial arts to witness private exhibitions of new inventions and objects of especial interest, and he was approached by Lord Kelvin, then Sir William Thomson, in behalf of a Mr. A. G. Bell, who, he said, wished to show his speaking telephone. To ensure quiet, Sunday afternoon was selected. The day was exceedingly warm and after repeated failures the crowd had grown very restless and impatient and Sir William came to Prof. Barker several times saying, "This is sheer nonsense." Presently, says Mr. Wallace, Sir William went to the other end of the line, and Mr. Bell, who had been nervously working over his apparatus, requested Dom Pedro, the Emperor of Brazil, who was among the party, to take the telephone and listen. "Do you hear anything, your excellency?" he enquired. "Yes," the white haired old savant tremblingly replied, beads of perspiration standing out upon his brow, and his eyes gleaming with nervous excitement: "I hear, 'To be or not to be, that is the question.'" This message, sent over the line by Sir William Thomson, was the first public message sent by telephone, and the scene, Mr. Wallace says, left an indelible impression upon his mind and on that of all others who were gathered there.



Prof. Morse's Trunk.



Philada July 5 1775

Mr Strahan,

You are a Member of Parliament,
and one of that Majority which has
doomed my Country to Destruction.
— You have begun to burn our Towns
and murder our People. — Look upon
your Hands! — They are stained with the
Blood of your Relations! — You and I were
long Friends: — You are now my Ene-
my, — and

I am,
Yours,
B Franklin

ELECTRICAL ENGINEER.

Franklin's Letter.

On September 15, 1849, Mr. Wallace was married to Miss Sarah Mills, of Birmingham, Conn., daughter of Thomas Mills. Mrs. Wallace has for many years past been a great sufferer and much confined to the house, and during Mr. Wallace's absence in Egypt a year ago, he received a cable announcing his wife's death. She left a son and daughter, William O. Wallace and Eloise E. Wallace, the former being married and living in Ansonia with his family, and acting as general superintendent of the works of Wallace & Sons. His daughter Eloise has for many years presided most ably over her father's household and assumed the care of her invalid mother. She is a woman of high intellectual attainments, an accomplished musician, and has traveled very extensively. The writer has been surprised to find in a woman such an amount of knowledge of electrical and mechanical matters. This is a taste that she has partially inherited, and further developed by her association with her father's work, into which she has entered with enthusiasm.

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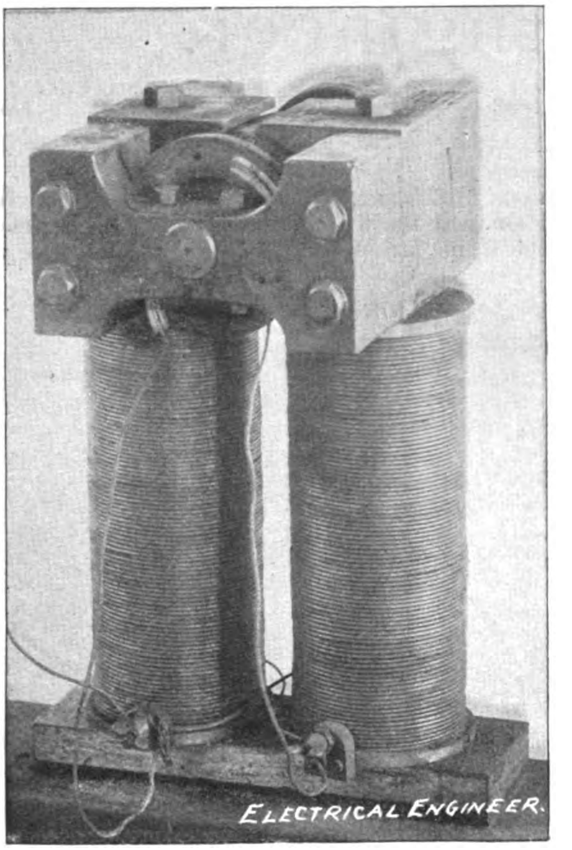
[1] Copyright, 1893, by W. J. Hammer.

V.

Although Mr. Wallace has always been exceedingly modest in his claims as a pioneer in the electrical field, he has always manifested the greatest interest in the work done by others in this and other departments of scientific research, and has been ever anxious to champion the cause of the early workers. He has ever had a penchant for collecting souvenirs of great scientific and historical interest, and his laboratory is filled with many such, gathered both in this country and abroad. On page 129 is shown an old trunk, once the property of Prof. Samuel F. B. Morse, with which he traveled about this country and Europe, and in which he carried many of his valuable papers and apparatus. His initials may be seen upon the top of the lid, and pasted in various parts of the trunk are labels indicating visits to various parts of Europe.



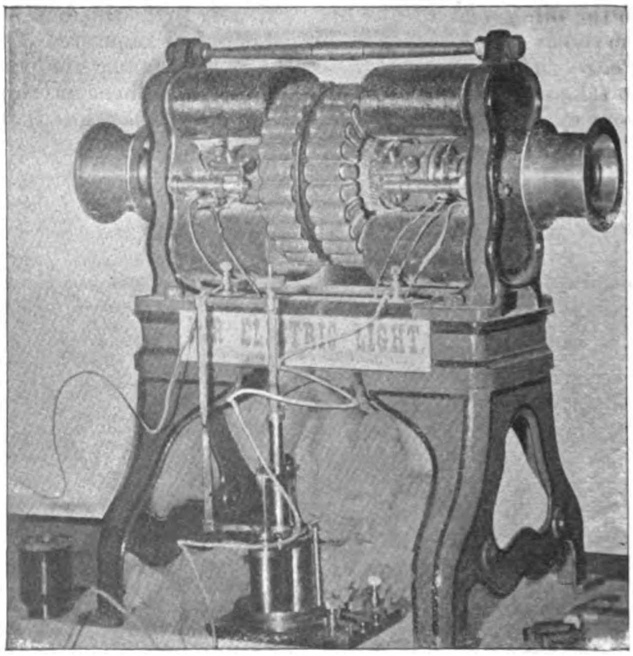
Wallace's First Dynamo of 1874.

Hanging up in the laboratory is shown a letter written by Benjamin Franklin to Mr. Strahan, a member of Parliament. This is also illustrated. It is considered one of the most interesting letters that Franklin ever wrote, and is now published in *fac-simile* for the first time. The illustration of Mr. Wallace's laboratory, shown last week, very inadequately represents the wonderful store of interesting things which the room contains, and it would be of great value to the Electrical Department of the World's Fair if they were to secure many of these valued relics for exhibition at Chicago during this year. The picture shows Mr. Wallace's large telescope, a number of his fine microscopes, his big Holtz machine, Crookes' apparatus, his magic lantern, and many other things of interest, and the cabinets and drawers about the room are filled with a marvelous collection of apparatus for experiments in electricity and magnetism, polarized light, sound and other departments of physics. The collection of lenses alone represents a not inconsiderable fortune. Upon the walls may be seen some of Prof. Draper's celebrated photographs of the moon, presented by him to Mr. Wallace, while here and there hang portraits of Faraday, Joseph Henry, Dr. Draper, and other well-known scientific men.

Besides being one of the largest manufacturers of copper and brass goods, Mr. Wallace has large interests in copper and gold mines in the West, as well as in iron mines in Virginia. At the time that laws were passed forbidding the mining of gold by hydraulic methods, at one time so extensively in vogue in the West, Mr. Wallace had considerable capital invested in this class of gold mining, which he says would have proved exceedingly remunerative but for the prohibitory laws which were passed because of the injury done to the scenery, the choking up of the streams, destruction of farming and grazing lands, etc., by the system of hydraulic mining employed. Besides these outside interests, Mr. Wallace has invested largely in stocks of important electric lighting and power enterprises. He believes in electricity.

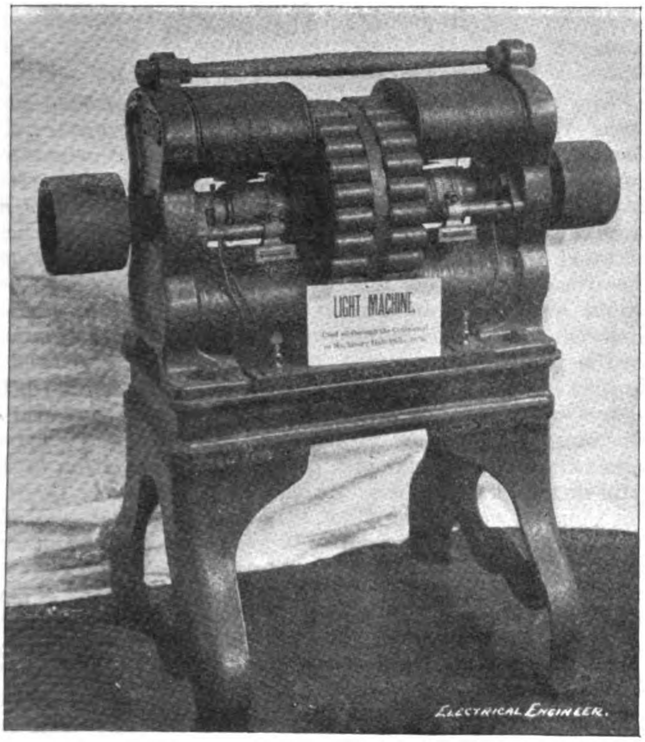
VI.

Mr. Wallace's work in dynamo electric machinery forms an exceedingly interesting chapter in this department of electrical development. He was the first builder of dynamos in this country, and the first manufacturer in America to apply the dynamo to the industrial art of electro-plating. Perhaps the readers of The Electrical Engineer may remember the great interest manifested in the fine display made by Mr. Wallace of his experimental types of dynamos and other historical apparatus which he exhibited at the Franklin Institute Electrical Exhibition in 1884. On this page is shown the first dynamo built in this country. It will be noticed that it consists of a simple horseshoe magnet inverted, between the poles of which revolves an armature of the Gramme type, the ring being quite broad. The brushes were attached to a rocker arm operated originally by a worm and gear, but not observable in the sketch here shown. This dynamo bears a marked resemblance to the Edison dynamo inverted, and resembles even more the recent standard types of dynamos of Siemens & Halske, of Kapp and others, made abroad, and of the Thomson-Houston incandescent type in this country. Having been constructed in February, 1874, it antedates all these, which, however, all employ the Siemens type of

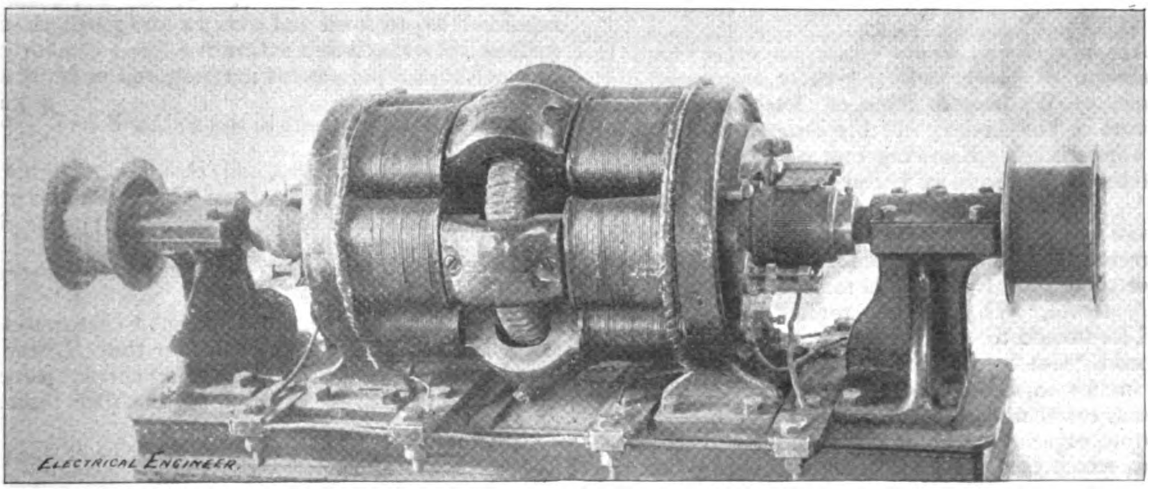


The Wallace-Farmer Dynamo.

armature. Considering historically this form of field magnet, it must not be forgotten that H. Wilde, of Manchester, brought before the Royal Society, April 26, 1866, a description of a dynamo having a field of the "horseshoe" form, the magnet being, however, very broad and flat, an armature of the Siemens shuttle-wound type, and the field separately excited by a magneto-machine.



THE CENTENNIAL ARC LIGHT DYNAMO, "WALLACE-FARMER."



THE "TELEMACHON."

Mr. Ladd later made a dynamo with upright fields broad and flat and of the same general construction as Wilde's. Still earlier, Pixii, E. M. Clark, Stöhrer, Gramme and C. W. Siemens constructed hand magneto-machines with upright "horseshoe" magnets of steel. The construction of the dynamo shown here was undertaken by Mr. Wallace after hearing from his intimate friend, Prof. Geo. F. Barker, of the University of Pennsylvania, of the wonderful Gramme dynamos he had seen in the Vienna Exposition of 1872, and in use also in London, that same year, at which time Werdermann, who represented Gramme in England, was making his experiments in lighting the tower clock of the Houses of Parliament by means of the Serrin arc lamp and Gramme dynamo. Mr. Wallace shortly thereafter built a number of other types of dynamos which I shall refer to later on, employing armatures of the Siemens, Gramme, Pacinotti, drum, and multipolar types, and his firm secured the services and co-operation of the well-known electrician, Prof. Moses G. Farmer, at that time residing in Boston. Prof. Farmer was contemporaneous with Werner Siemens in his discovery that the current generated by the armature could be utilized for the energizing of the field magnets, rendering separate excitation of the field by magneto-machines unnecessary.

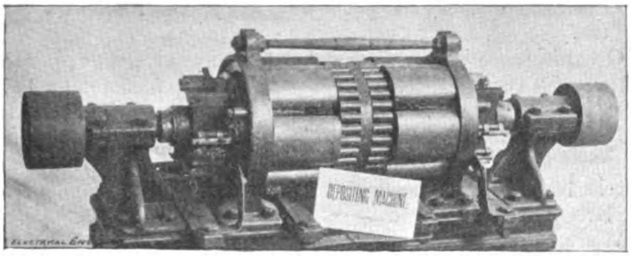
Farmer took out a patent in 1872, covering the combination in one circuit of the armature, field, line wire and work done. He built a dynamo with multiple-poled field and armature, which was considerably improved by Mr. Wallace, who gave it the permanent form as shown on page 130. The magnetic field was produced by two horseshoe electromagnets with opposite poles facing each other between the arms of the magnets, and passing through the uprights supporting the magnets is the shaft carrying the rotating armature. This consists of a disc of cast iron near the periphery of which are 50 wedge-shaped iron cores wound with wire, 25 being set at right angles to each face of the disc, thus forming a double series of coils. It will be noted that this is really a double machine, each set of coils having its commutator and being capable of being used independently. In practice the electrical connections were so made that the currents generated in two series of armature coils pass through the field coils and are joined in one external circuit.

On this page is illustrated the Wallace-Farmer dynamo which was run all during the Centennial Exposition of 1876, where it supplied the first electric lights started up and the only one used for illuminating the Exposition buildings and grounds. In addition to this, the Gramme dynamo and Serrin lamp were shown as an exhibit in the French section by Breguet.

Wallace & Sons began the manufacture of this type of machine for the market early in 1875, constructing it especially for arc lighting in conjunction with the Wallace "Plate Carbon" arc lamp, continuing however extensive experiments in dynamo construction.

The most interesting machine resulting therefrom is also shown on this page, termed by Mr. Wallace, the "Telemachon" and described as being for the development of power at a distance from its source. It was constructed in November, 1875, and was exhibited at the Centennial Exhibition at Philadelphia, in 1876. A record in the shop states that this dynamo at a speed of 1,000 revolutions supplied eleven arc lamps when driven by an inch and a quarter belt, the pulleys being eight inches in diameter. This machine contained a Gramme ring armature, and the most interesting fact connected with it is that it is the first armature in which laminated plates of iron were used. Mr. Wallace says: "In those days we knew nothing of hysteresis, eddy-currents, or Foucault-currents, but I was aware that there was a loss caused by what I termed interference of magnetism, and made the core of iron plates twelve in number separated by shellaced paper to obviate this difficulty. My experiments in building induction coils suggested my breaking up or laminating the iron core." Mr. Wallace says he believes this machine has to-day no superior in the market. As with the Wallace-Farmer dynamo, the armature possesses two sets of coils and two commutators and a driving pulley at each end of the shaft, it being considered as an advantage in driving, and by use of two driving belts lessening the risks, saving wear upon bearings, etc. Many experiments were made with this machine in running the circuits separately, in series, and in multiple for various purposes, though I believe it never occurred to anyone to try it as a motor transformer, which, one would think, would naturally have suggested itself.

This is the machine which Mr. Frank J. Sprague referred to at the Providence Convention of the Nat'l Elec. Lt. Assn. in 1891. An extract from Mr. Sprague's remarks are worthy of reproduction here: "Well, by some good intervention, I was ordered back to the United States, and I went to Ansonia, Conn., where I saw an experiment in the transmission of power which greatly impressed me. Mr. Wallace, of Wallace & Sons, of Ansonia, is a man whose position in the history of this enterprise has never been fully appreciated. Knowing him personally, he took me through his factory, and said 'Sprague, let me show you something.' He had one of those old two-pole armature machines, and had connected it with a dynamo. He turned on the current, and pretty soon the armature was running two or three thousand revolutions a minute. He said, 'It is no good.' I said, 'Why?' He replied, 'I will show you.' And he turned to one of the men—a large strong man—and said, 'Get hold of the pulley.' The pulley was about ten inches in diameter. The man threw his arms around it and, lowering its speed, finally brought it to rest. In that simple experiment he outlined, and he overlooked, the most important fact that he had to deal with—that the work done was not determined by the torsional effort alone, but that this should be multiplied by the speed at which the pulley rim was travelling. Had Mr. Wallace seized on that single point, or had I, at that time, the transmission of power would then have been very much advanced."



THE CENTENNIAL PLATING MACHINE, "WALLACE-FARMER."

The cut on this page represents a special type of Wallace dynamo for electro-plating purposes. This machine was shown at the Centennial Exhibition at Philadelphia in 1876, and built first in the year previous. This machine was capable of heating to a white heat 18 feet of number 8 B. and S. gauge copper wire. Wallace & Sons still manufacture plating machines, though confining their attention to the well-known "Little Joker" plater. This is the only type of dynamo now manufactured by them.

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY.—XV.

BY

A. E. Kennelly

STRESS DISTRIBUTIONS (CONTINUED).

Now suppose the polar surfaces reduced to 1.5 sq. cms. each. With the same total flux through the armature, the density at the contact surfaces will be 13,333, representing a stress of 7.3 kilogrammes per sq. cm., or a total stress at each pole of 10.95, and for both poles combined 21.9, an increase of 5.68 above the preceding case. We have here assumed that the total flux of 20,000 lines passed through the armature was the same in each case, but in reality there would be some reduction in the flux as the polar surface diminished, and this reduction would become more marked as the polar area reduced, so that finally when the flux density in the soft iron at the polar areas approached 18,000 C. G. S. lines per sq. cm., or in other words, as the iron at those areas approached saturation, the advantage gained by increasing B would be just offset by the reduction in the total flux that would pass through the surfaces. Beyond this point of maximum effect, still further reduction of the polar contact areas would result in a lessened total attractive force. This maximum would depend upon all the conditions of the magnetic circuit, and its determination may be left for later consideration.

These principles also explain the advantage that is secured for permanent magnets of hard steel by softening their poles when these latter are of due proportions. Hard steel is necessary for their construction in order that the countermagnetic flux from their poles may not demagnetize them, but at the polar surfaces, it is desirable to have B^2, and therefore B, as great as possible for a large tractive power, and soft steel will more readily permit a high intensity to be obtained.

Similarly they indicate the necessity for employing a permanent magnet in a receiving Bell telephone in place of a soft iron core. Assuming that the diaphragm of ferrotype plate is so close to the pole, that the flux density may be regarded as uniform and everywhere perpendicular to the surfaces, the maximum attractive force due to a soft iron core without a permanent magnet, and under the influence of an alternating current in the coil, will be $\frac{A\,B_c^2}{8\,\pi}$, where A is the effective polar area, and B_c is the maximum intensity that the alternating current can effect. The insertion of the bar magnet produces a steady normal pull on the diaphragm of $\frac{A\,B_m^2}{8\,\pi}$ dynes, where B_m is the permanent magnetic intensity. If this is not nearly sufficient to saturate the iron at the polar surfaces, we may consider that B_c may be superposed upon B_m when the alternating current passes through the coil. The stress exerted on the disc then alternates between $\frac{A}{8\,\pi}(B_m + B_c)^2$ and $\frac{A}{8\,\pi}(B_m - B_c)^2$, a total range of $\frac{4\,A\,B_m\,B_c}{8\,\pi}$ which is generally much greater than the original value $\frac{A\,B_c^2}{8\,\pi}$ and the electromagnetic effect of the coil becomes correspondingly augmented in the ratio of $4\,B_m$ to B.

Experiment shows that the friction to sliding between two smooth or nearly smooth surfaces of iron under magnetic stress, is not sensibly different from that accompanying the same stress exerted mechanically, so that if f is the coefficient of friction (sensibly 0.2) between ungreased

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1. Copyright 1892, by A. E. Kennelly.

smooth surfaces of iron, the stress that it will be necessary to apply between them parallel to the plane of contact will be $\frac{f}{8\pi}\int B^2\,ds$, or about one-fifth of the total tractive force.

The subject of tractive power of magnets has been extensively developed in Professor S. P. Thompson's "Electromagnet."

The fact that the intensity of magnetic stress varies as the square of the flux density, and that the total stress is the ultimate sum of all the intensities, into the area over which they are exerted, as expressed by the equation $P = \frac{1}{8\pi}\int B^2\,ds$, is the clue to all the most important phenomena of attraction between magnets. It explains, for example, the seeming paradox that an electromagnet will often support a heavier weight from its armature after the contact surface between poles and armature is reduced. For if the flux through the armature is say 20,000 lines, and the polar surfaces two sq. cms. each, the density will be 10,000 per sq. cm. corresponding, by the curve of Fig. 34, to a stress of 4.056 kilogrammes per sq. cm. and the total pull will be 8.11. Since this stress will be exerted at each pole, the keeper should support at a point midway between them a total weight of 16.22 kilogrammes minus its own weight.

LAMINATED OR DIVIDED IRON AND OTHER METALLIC MASSES IN ELECTROMAGNETIC APPARATUS.—VI.

BY

Thos D Lockwood

Joseph Henry.

AT the head of the first list, which patriotically consists of the U. S. Patents, stands the patent of Chas. F. Brush, for his dynamo, No. 189,997 granted April 24, 1877. This patent, speaking of the armature, says that it may be made "of a uniform ring or band of iron, or a bundle of iron wire, or ribbon, or a series of parallel discs with the iron projections between the sections of copper wire." As is well known, the Brush armature core is slit up all kinds of ways, for the suppression of parasitic currents; and this style of construction is more especially disclosed in a second patent to C. F. Brush, No. 203,413, granted May 7, 1878.

This patent states clearly and forcibly the disadvantages of undivided iron in armature cores, and the necessity of dividing them for the purpose of avoiding heat due to currents induced in the iron. It recognizes the former patent, but says this is different, because it insulates the component parts of the core from each other. It will be seen from Fig. 4 that cuts in the iron are made radially, concentrically, and across the thickness; and also that it is contemplated to form the ring from separate flat or separate concentric insulated rings.

Patent No. 209,532 was granted to Edward Weston, Oct. 29, 1878, and is for a dynamo having an armature core which may be built up of discs mounted on a shaft; and which is also longitudinally bisected by a slit to prevent the circulation of induced currents in the core.

In 1879 I find three U. S. Patents showing the division feature. These are: No. 211,611, Jan. 4, 1879, E. Weston; No. 219,157, Sept. 2, 1879, E. J. Houston and E. Thomson; No. 219,398, Sept. 9, 1879, Otto Heikel; all of which are for Magneto or Dynamo Electric Machines.

The Weston specification says that one feature of the invention consists "in forming the armature core of thin wrought iron discs or rings;" and the inventor further states that he builds "up his armature of thin wrought iron discs," and exhibits such a construction, in Fig. 6 of his patent.

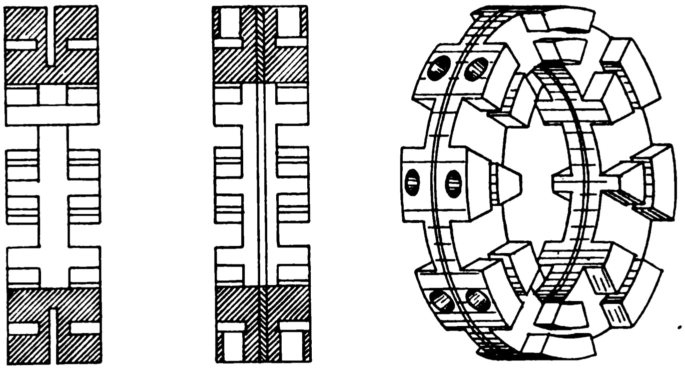


FIG. 4.

In the Houston and Thomson patent, both field magnet and armature core are divided. The specification referring to the former, says: "The cores of the field magnets are made of separate pieces of iron, not in electric contact with each other. This is obtained by forming the cores of plates or rods filed into the desired form, or they are made by rolling a sheet of iron into the desired form;" and referring to the armature, that "its core consists of one or more pieces of iron, of circular or polygonal shape, and provided with projections extending radially outward from them. To avoid heating of the core, many such pieces are placed side by side upon the same axis to make up the armature core in the form of a deeply fluted cylinder."

The armature core of the Heikel patent, to quote the specification, "is composed by preference of rings or of insulated wire wound helically, but it may be a plain iron cylinder."

Five U. S. Patents appear in 1880, requiring notice, viz: No. 223,557, Jan. 13, 1880, Thomson and Houston; No. 226,483, April 13, 1880, J. E. Braunsdorf; No. 228,544, June 8, 1880, H. S. Maxim; No. 232,910, Oct. 5, 1880, Thomson and Houston; No. 223,047, Oct. 5, Elihu Thomson.

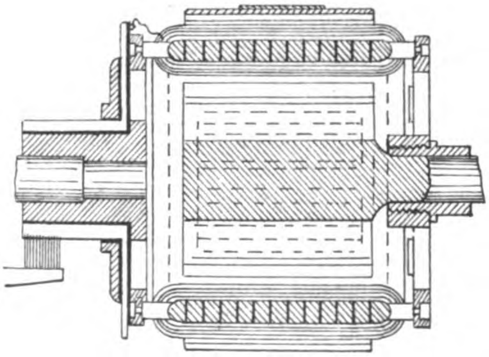


FIG. 5.

These again are all for Magneto or Dynamo Machines, and all comprise divisions of the armature core. They do not, however, disclose features of material novelty, and do not require further consideration; each of them might concur in the statement made by the third, No. 232,910, that "to avoid induction currents in the core, each separate section is constructed as shown, of several separate pieces formed and piled so as to produce the required form."

Nine other exemplifications of the principle appear as U. S. Patents in 1881. These are: No. 242,203, May 31, C. A. Hussey; No. 242,561, June 7, H. C. Sample and F. Rabl; No. 245,900, Aug. 16, E. Weston; No. 247,632, Sept. 27, W. Glass; No. 248,822, Oct. 25, L. G. Wooley; No. 249,017, Nov. 1, J. A. I. Craig; No. 249,148, Nov. 1. C. E. Long; No. 249,634, Nov. 15, C. P. Jürgensen; No, 251,537, Dec. 27, T. A. Edison. These, as usual, are all for Magneto or Dynamo Electric Machines.

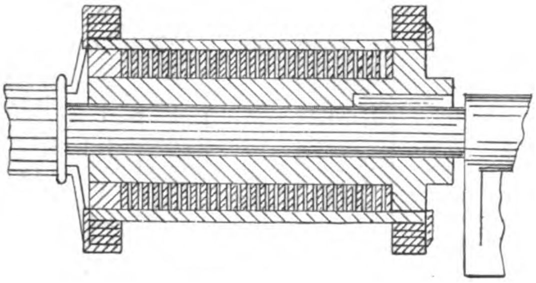


Fig. 6.

Hussey's armature "has a core composed of a number of plates arranged side by side, in close proximity to each other." The Sample and Rabl machine has a ring armature "which is composed of alternate rings of perforated sheet metal E, and wire gauze F, held together by pole pieces G insulated from each other." In the Weston patent the armature is "built up of thin iron perforated plates." The armature of the machine of the Glass patent "is made by winding iron wires round a non-conducting cylinder, and preventing magnetic contact between them by enveloping them with a thin layer of non-magnetic substances." That of the Wooley machine is described as being composed of a series of iron strips or bars magnetically insulated from each other. The specification says: "The armature being composed of a number of iron bars, each bar is magnetized and demagnetized very quickly, thus avoiding nearly all the back-pull common to armatures composed of a large body of iron made in a single piece." These two last instances both emphasize their expectation of facilitating magnetic change.

The Craig patent is noticeable for its full recognition of the prior art, and its rings are made up "by stamping segments out of sheet iron, and piling these segments up into the desired thickness, then forming out of the piled up segments an armature cylinder."

The armature of the Long machine also is formed to facilitate magnetic change rather than to break up eddy currents, and is formed of a number of sheet iron plates alternating with plates of non-magnetic material.

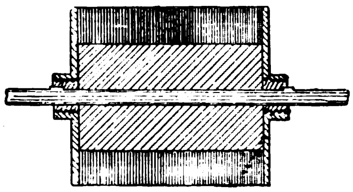


Fig. 7.

The well-known Jürgensen machine has its moving ring made up of plates as shown in Fig. 5. The specification of its patent states that it is preferred "to construct the core of the ring-formed revolving armature of annular or ring-shaped sections, which are separated from each other by rings of hard rubber or other insulating material." The Edison core is built up as shown in Fig. 6, of discs or rings separated by paper; it does not form a prominent feature of this patent, being, as the specification states, described in former applications.

Two more U. S. Patents complete the list; they are: No. 256,778, Apr. 18, 1882, E. Weston; No. 265,785, Oct. 10, 1882, T. A. Edison. The armature core of the former does not differ materially from that of former Weston patents; but that of the latter is noticeable for the extreme care which is taken to insulate each component disc from its neighbor, and the whole from the remaining parts of the machine. The magnetic portion of the core is "composed of iron rings made of thin sheet metal divided by rings of insulating material, tissue paper being preferred for the purpose." Fig. 7 indicates the appearance in cross-section of such an armature.

NON-SYNCHRONOUS MOTOR FOR ORDINARY ALTERNATE CURRENTS.

BY

C. E. L. Brown

After numerous experiments with multiphase motors, I had become convinced, about a year and a half ago, of the possibility of constructing motors for ordinary alternate currents possessing all the characteristics which, till now, have been attainable only by the use of multiphase currents. Among these characteristics of multiphase motors I would specially call attention to the following:

First and most important, absence of collectors and brushes, and consequent simplification of design and reduction in the amount of attendance necessary. Secondly, the possibility of starting the motor against a load; and thirdly, non-synchronous running with the various advantages connected therewith.

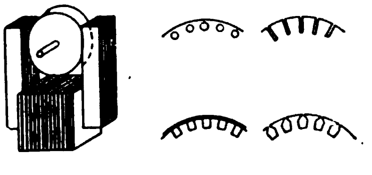
The absence of collectors has in very many cases the result, that the multiphase motor must be considered preferable to the direct current motor, so that, without exaggeration, we may say, that the alternate current (though not, it is true, in its simplest form) is considerably in advance of the direct current as a means of driving motors. When we also consider the ease with which the alternate current may be transformed, we can understand how, in all the newer power-distribution schemes, the alternate current (of two or more phases) has been employed. A disadvantage is nevertheless soon apparent, to which too little attention was at first given, viz., the complication of the mains arising from the fact that more than two wires are necessary. This disadvantage is chiefly apparent in cases of combined distribution of light and power, and creates a demand for a motor for ordinary alternate currents, of equal simplicity with the multiphase motors and possessing their various advantages.

Attempts have not been wanting to produce such motors. This is best seen by the large number of patent specifications filed, in hopes of attaining this end. I do not here propose to consider in detail these attempts, merely remarking, that they have been all more or less unsatisfactory, none of them having, to my knowledge, been adopted in practice. The reason of these unfavorable results seems to be the same as, until recently, prevented the construction of practical multiphase motors. I refer, primarily, to the want of attention to the magnetic resistance of the air gap; owing to the abnormal magnetizing current required, the windings, even while the motor was running light, became so warm that continuous running was out of the question. The efficiency was also, consequently, very low. I have, as is well known, by placing the wires in holes through the iron (both of the fixed and rotating parts), entirely overcome this difficulty, and thus produced the first really practical multiphase motor. Another defect was in the form of the magnetic circuit, with salient poles which produced injurious reactions in the induced part, rendering the starting of the motor very difficult.

I would also call attention to another point, which is specially noteworthy in American practice, viz., the high frequencies commonly employed. This causes difficulties from the great counter E. M. F. of self induction, as well as from the inconveniently high number of poles required on small motors, in order to avoid excessively high speeds. There are several other reasons why these earlier experimenters have failed, but I have, I believe, enumerated the most important above.

After these preliminary remarks I will now proceed to describe my new motor, first noting the remarkable phenomena upon which the principle of it is based. I have observed, that a conductor, placed in a alternating field, (see Fig. 1) if set rotating with a certain velocity, will itself run up to practically synchronous speed, and then has the tendency to keep to this speed against a load. Currents are induced in the conductor by the alternating field. So long, however, as it is at rest, these currents are neutral with regard to the inducing field. As soon as the conductor is set in motion this condition ceases, and a turning moment is produced, which increases as the speed rises, till synchronism is nearly attained.

The following points should here be noted: With a conductor in the form of a solid disc, for example, the speed will drop more or less below synchronism, according to the load. With a deeply serrated conductor, on the other hand, or one consisting of but few members, the tendency is to preserve almost exactly synchronous rotation, and if the speed once falls much below this the torque is considerably reduced.

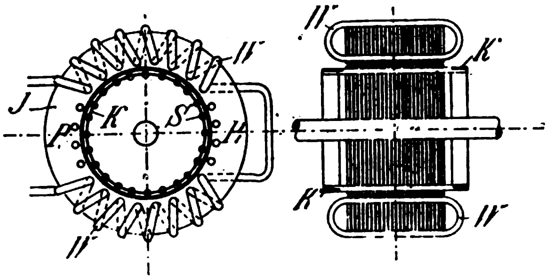


Figs. 1, 2, 3, 4 and 5.

It must also be noted that the direction of rotation is quite indeterminate. The conductor tends always to attain synchronous rotation in the direction in which it was first set in motion. The arrangement shown in the diagram Fig. 1 is, of course, not suitable for practical motors. In designing a motor based on these facts, the following points must be kept in view. The alternating field must be as strong as possible and all magnetic resistances (as well in the inducing as in the induced parts) must be reduced to a minimum. Injurious eddy currents in both iron and copper must also be avoided as much as possible. These various requirements can be satisfied in the following manner: The inducing winding (*i. e.*, that in connection with the mains) as well as the induced (receiving its current by induction from the former) is provided with iron cores consisting preferably of iron discs insulated from one another.

In order to reduce the magnetic resistance, the windings are embedded in iron, either in holes of suitable shape, Fig. 2, or between teeth, Fig. 3, which may be advantageously closed by a winding of iron wire, (Fig. 4). The teeth may also, as in Fig. 5, be widened, so as to nearly close the opening. Either inducing or induced parts may, of course, be provided with either of these arrangements.

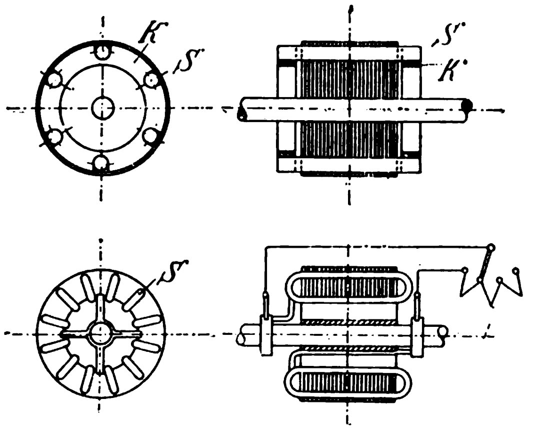
The inducing winding may be, of course, of any of the usual forms, with a suitable number of poles, the sections being connected in series, parallel or in a combination of both. The induced, which is usually also the rotating part, since sliding contacts are thereby avoided, carries a short-circuited winding preferably insulated from the core, in order to avoid eddy currents. This short circuiting may be carried out in various ways. All the ends at each side may be connected together by means of two copper rings, or the conductors may be connected in certain groups, which are separately short circuited. Or, again, wires similarly situated with regard to the external field may be separately short circuited with one another. Another method is to wind the induced part as ring, drum, etc., with a short circuiting connection. For regulating the speed a resistance, choking coil, or a capacity may be inserted in the short circuit.



Figs. 6 and 7.

Figs. 6 and 7 serve to show the most important points about a motor designed on the above principles. The inductor J is shown fixed, and consists of a cylindrical core of laminated iron. The discs, of which it is built up, are perforated near their inner edges and carry the winding W, here shown as a ring (it could, of course, equally well be wound as a drum). The winding is not shown extending over the whole ring, but there is nothing to prevent its being so arranged. The connections are such, that poles are produced at P P'. The rotating part consists principally of a laminated iron cylinder carrying insulated copper wires S in holes close to its circumference. These wires are soldered at each end to stout copper rings K.

A somewhat different arrangement is shown in Figs. 8 and 9. This has the property, described at first, of almost synchronous running. Here again copper conductors S are bedded in a laminated iron core and soldered on both sides to stout copper rings K, the only difference being that the number of conductors is here very small.



Figs. 8, 9, 10 and 11.

Figs. 10 and 11 show another type of rotating induced part, provided with a ring winding S. Two opposite points are here connected to sliding contact rings, so that a resistance for regulating the speed may be readily inserted.

A motor constructed according to the above principles and suitably proportioned has a remarkably high weight efficiency. I have designed a non-synchronous motor, for example, weighing only 150 kg., which at about 2,000 revolutions could be loaded to 6 h. p. without excessive heating. Its efficiency is very good and the apparent watts are but very slightly more than the true watts. The outside dimensions of the motor without pulley are: Length (along shaft) 430 mm.; greatest height 350 mm.; greatest breadth 340 mm. These figures suffice, I think, to show that the output of this form of motor is scarcely behind that of one for direct or multiphase currents.

I may here briefly touch upon an important point, viz., the predetermination of the so called "idle" or magnetizing current, as it is, of course, necessary, in designing a motor, to be able to calculate this current. Experiments with a large number of motors of various outputs show that this may be done with sufficient accuracy for practical purposes, the observed currents differing in most cases by only a very small percentage from their calculated values. The same principles hold here as in the design of ordinary dynamo machines.

A convenient formula for determining the necessary values is that of Kapp (in his paper on "Alternate Current Machinery"). It is as follows:

$$V = C \sim L\, W.\, 10^{-8}.$$

Where

V = E. M. F.

C = a coefficient expressing the ratio between the E. M. F. of alternate and continous current machines.[1]

$\sim$ = Number of complete cycles per second,

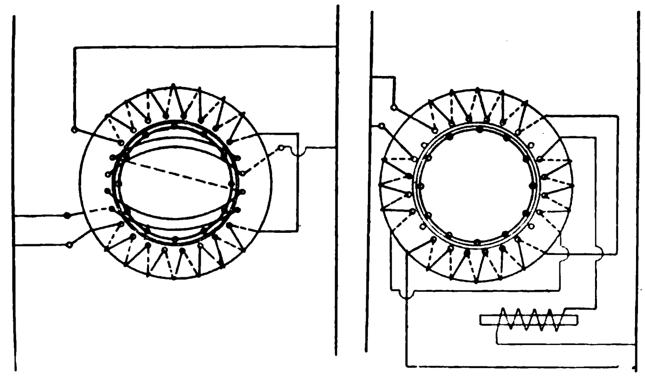
L = total number of lines per pole,

W = total number of wires in the inducing part.

By substituting the values of V, C and W, we may find L, the total induction, and from this the density of the lines both in the fixed and rotating parts, as well as in the air gap separating them. The mean length of the lines is taken at once from the drawing; and from these data, by the wellknown method of Hopkinson, the ampere turns necessary to produce this magnetization can at once be found. The number of wires being given, we thus have the value of the idle or magnetizing current.

Having found the current required to run the motor idle, we may easily determine with sufficient accuracy that required with a load. We may do this as with transformers having open magnetic circuits, since in both cases the idle current lags 90° behind the working current. We have the following equation:

Resultant current with any load $= \sqrt{I_i^2 + I_w^2}$.



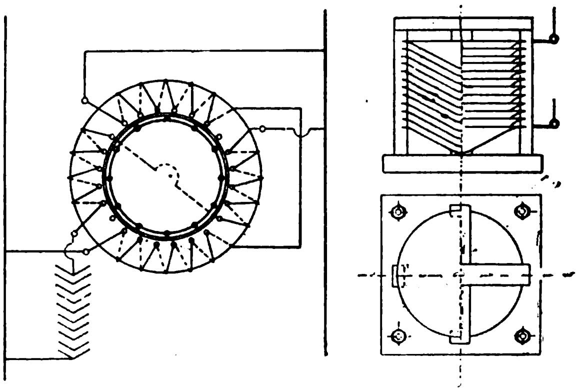
FIGS. 12 AND 13.

Where I_i = idle current,

and I_w = working current.

If, for example, a motor takes 30 amperes idle current and 100 amperes working current, we have for the resultant current $I = \sqrt{30^2 + 100^2} = 105$ approximately; that is, but few per cent. more than the working current. As regards induction in the iron, current density in the copper, etc., similar rules apply as for ordinary dynamo design.

As it would have occupied too much space to go at length into all the questions involved in the calculations for these motors, I have above merely sketched out the broad principles, upon which they rest, wishing especially to point out, that the calculations for such motors are similar to those which have long been in use for direct current machinery.



FIGS. 14, 15 AND 16.

I may add, that what I have said above applies equally to multiphase motors, and in fact it should be clearly understood, that with both broad types of motors, the same principles apply throughout.

A motor designed in accordance with the principles described above has properties similar to a multiphase motor, *i. e.*, has no collector, runs non-synchronously, and, as far as efficiency and output are concerned, is also very similar. In one respect only does it differ considerably from a multiphase motor, viz., it will not start itself, and some method must therefore be found of neutralizing this disadvantage. There are various ways of doing this of which I will describe a few.

The motor may, for example, be provided with a second winding, wound in the spaces of the first, and which, being only a short time in action, may be of relatively small section. By giving this winding a different self-induction to the first and connecting the two in parallel, the resulting phase-difference produces a rotating field, starting the motor and bringing it up towards synchronous running. This second winding can now be cut out and the motor continues to run as a single phase motor as shown described. The difference of phase in this second winding can be attained in various ways. One method is to wind one section as a drum and the other as a ring, as shown in Fig. 12, as it is well known that the latter has considerably greater self induction than the former.

We may further attain the same end by connecting a self inductive device, Fig. 13, or capacity, Fig. 14, or a resistance in series with one section. This method may of course be used in conjunction with the above described mixed winding. In order to obtain conveniently the necessary capacity, we may use a series of elements, which Messrs. Stanley and Kelly have also lately employed in their experiments with alternate current motors. A very convenient form of water capacity consists of a large number of iron discs dished out to a conical form, piled together with insulating distance pieces to allow room for the liquid. (See Figs. 15 and 16.) A solution of soda in water may be employed for filling. As a further method of obtaining the necessary difference of phase, suitably proportioned transformers may also be employed.

By means of this difference of phase, in a suitably proportioned motor, a very considerable starting torque may be obtained. Thus I have succeeded in getting, with a 1 to 1½ h. p. motor, a torque corresponding to a load of 3 h. p. at full speed.

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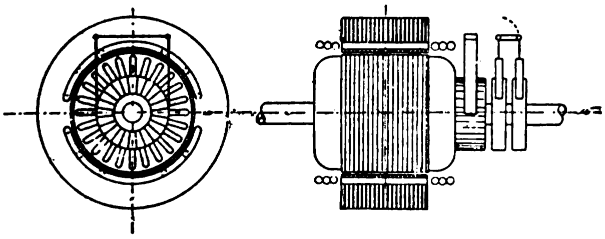
[1] In the above mentioned paper will be found the values of C for various cases commonly occurring in practice.
Herr Görges has extended this table, giving values for other cases. (*Elektrotechnische Zeitschrift*, 1892.)

Another method of starting single phase motors consists in providing the induced, usually the rotating, part with a winding connected with a collector Figs. 17 and 18. By means of suitable brushes we may either supply this winding with current from outside or the brushes may simply be short circuited. As soon as the latter are in their proper position with regard to the external field a powerful torque is produced and the motor starts. As soon as a sufficient speed is attained, the collector may be short-circuited by means of brushes pressing on contact rings connected with opposite points of the winding. Or the winding may be short-circuited by means of a conducting ring brought into contact with the collector. The motor then works in the manner described above. In this case the inducing part is wound in the simple normal manner, *i. e.*, it requires no second winding, for the purpose of obtaining a difference of phase. On the other hand, the induced part has, instead of its simple short-circuited winding, a drum or ring winding, or it may be wound like the armatures of the Thomson-Houston or the Brush arc light machines.

Having now described a few methods by means of which the motors may be started, I must not omit to say, that these non-synchronous motors for ordinary alternate currents may be built of any size, from quite small types to machines of 100 h. p. and more. I believe, that I shall not go too far, when I say, that in the above described simple motors, we have a means of securing the speedy and certain extension of the use of ordinary alternate currents. These motors will be especially employed where light and power together must be supplied in the simplest manner possible.



FIGS. 17 AND 18.

As regards amount of attendance necessary and safety in running, these motors are considerably in advance of those for direct currents, and as regards commercial efficiency for the same size, output, and speed are equally good. I am of the opinion, that this new type of motor will displace multiphase motors in all those cases, where in addition to general lighting, power must be supplied, while for power distribution alone the multiphase motors will still find a use. In light and power distribution systems, having the so-called two phase current, an advantageous combination of the two types of motor may be made. Thus small motors may be connected simply to one phase like the lamps, while larger motors could be connected to both phases. I have now, I believe, described briefly the principal points of this type of motor; it is not yet possible to go further into details, especially as several questions with regard to patents are still to be settled. However, I hope that it will be possible before long to give a more detailed description of some large installations, employing this type of motor.

STARTING THE LIVERPOOL ELEVATED ELECTRIC RAILWAY.

ON Saturday, February 4, the Liverpool electric "elevated," which has already been described and illustrated in our pages, was successfully started, Lord Kelvin, the Marquis of Salisbury, and many other notables being present. The trial trip over the road was made at a speed of 22 miles an hour. The road runs along the river Medway and docks' front, and is a massive iron structure with occasional viaducts. It ends in a handsome terminal depot. The motors are under the cars, and the current is picked up from track conductors. There are several stations along the line. An interesting feature of the road is the manner in which it traverses drawbridges and tilting bridges.

A NEW RULE FOR DETERMINING THE DIRECTION OF INDUCED CURRENTS.

BY

Herman A. Strauss.

IN attempting to explain the phenomena of induction to minds just beginning to grasp the abstractions of the science, I have found that Dr. Fleming's "Hand" rule for remembering the connection between motion, magnetism and induced current often confuses the student, seemingly from the lack of exactitude attending the attempt to portray the three rectangular axes by means of the fingers and thumb.

Compelled to find some more striking representation and anxious to remain consistent, I have produced the following rule, which, from the good results it has yielded me, may perhaps prove useful to others. It reads thus:

Stand in the direction of motion, so that the line of motion traverses the body from the feet to the head.

Look along the Lines of Force, that is, face the South pole. Extend the left hand to the left. The induced current will then be leaving the fingers of the extended hand.

RAILWAY TELEPHONY.

MR. C. A. HAMMOND, superintendent of the Boston, Revere Beach & Lynn Railroad, in a recent paper published in the *Railroad Gazette*, calls attention to the growing tendency among railways to the use of the telephone in place of the telegraph in the transmission of train orders; and he urges its wider adoption for the purpose. Within the past year or two, the entire telephone service of his road has been changed to copper metallic circuit, using long distance transmitters with sufficient battery power to allow a dozen or more instruments to be placed on a single circuit; individual calls being distinguished by long and short rings as in the Morse code. Care has been taken to neutralize induction, and the line is found to be perfectly quiet day and night. The writer is of the opinion that there is no reason why the telephone, if proper precautions are taken, is not preferable to the telegraph for this class of work. The rule has been for the sender of a message to write it down as he talks and have the receiver write down what he hears, repeating the message as a check. As an instance of working of the system, Mr. Hammond states that he has on file 2,500 train orders in which there is not a single error of vital importance.

ARC LIGHTS AND LONDON FOGS.

A LONDON electrical paper states that arc lighting for streets has received a remarkable vindication during the recent heavy fogs in London, and it quotes from the daily papers a description of the excellent service rendered by the electric light through one of the heaviest fogs of an exceptionally foggy year. The electric light is practically only just coming into use in the London streets, yet an opportunity was afforded on the day in question to establish a fair comparison of the relative merits of gas and electric light in a dense atmosphere. An unanimous decision was recorded in favor of the electric light, and it is further stated that men who have spent the whole of their lives in the city of London were of opinion that the traffic in the streets which during a fog is always more or less impeded, and sometimes brought almost to a standstill, was facilitated by the increased power of illumination to an extent never before known.

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Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
Western Editor and Manager, L. W. COLLINS, 575 The Rookery, Chicago, Ill.
New York Representative, 203 Broaway, } W. F. HANKS.
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Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XV. NEW YORK, FEBRUARY 8, 1893. NO. 249.

ATTITUDE OF THE GENERAL ELECTRIC COMPANY.

THE ELECTRICAL ENGINEER has great pleasure in directing the attention of its readers to the subjoined letter of the General Electric Company.

GENERAL ELECTRIC COMPANY
44 Broad St., New York.
620 Atlantic Ave., Boston.

Office of Assistant General Manager.

NEW YORK, Feb. 3, 1893.

To the Editor of "THE ELECTRICAL ENGINEER,"
203 Broadway, City.

Dear Sir:—The spirit of fairness which has always characterized your paper will probably lead you to give us an opportunity to comment on an article under the head of "Legal Notes" in your paper of Feb. 1st, which seems to us to convey an absolutely false impression.

The circular issued referring to Supply Houses and other middlemen cannot be said to disclose any policy on the part of this company. The difficulties of the present situation are such that we have been obliged for the time being to refuse to sell lamps except to the users, because in no other way can we meet our obligations to the licensees of the Edison Electric Light Company, whose contract rights must be respected, and who have sent us frequent complaints that Edison lamps were sold in their territory where they have the exclusive right to use and sell, without their knowledge or consent. We recognize, and believe that the public will recognize, that the Edison Licensees have definite and absolute rights which they are entitled to enforce. Certainly neither the General Electric Company nor the Edison Electric Light Company has any right or power to interfere with its licensees in such action as the latter may deem wise for their own interests.

The suggestion that the General Electric Company has notified "various parties that if it does not get the order for generating apparatus the supplies of necessaries to run it, so far as the General Electric Company controls such supplies, will be withheld," is entirely without foundation. In the present situation of the lamp litigation it is impossible to adopt a general policy applicable to all or to the majority of cases, and the General Electric Company certainly is in no position to announce a policy until it has formulated one. For the present we propose to use every effort, first to protect the licensees of the Edison Company in their vested rights, even at the sacrifice of the large amount of business that would otherwise come to us through the Supply Houses; and second, to meet each user of incandescent apparatus who desires to purchase lamps of us, fairly and endeavor to accommodate him, if possible.

Yours truly
S. D. GREENE,
Ass't Gen'l M'g'r.

That portion of the letter referring to the Company's circular addressed to supply houses and others, in which it declines until further notice to fill orders for lamps except when coming from actual users, may properly be read in connection with Mr. Grosvenor P. Lowrey's assurance to the Court, in the course of his argument for complainants in the Sawyer-Man case a few weeks ago, that he "was "authorized to say that it was not the intention of the "General Electric Company, or of the complainant [the "Edison Electric Light Company], to refuse to sell lamps "for use on Westinghouse machines. They desired to sell "their lamps everywhere, had put them in the hands of "supply dealers for sale and did not intend to take them "out of the supply dealers' hands; anybody who wanted "to buy them would continue to find them there." It is gratifying to be assured by the General Company, that its withholding of lamps from dealers and all but actual users is not to be taken as disclosing a permanent policy, but is for the time being only; pending—it is to be inferred from the above letter—some adjustment of the difficulties arising from the contract obligations between the General Company and the Edison licensees. No reasonable persons, however interested, will gainsay the right of such licensees to protection under the Edison patent while it is in force, or fail to recognize the complexity and difficulty of the present situation for the General Company; difficulty and complexity, however, not too formidable for solution by the ability, administrative and legal, at the command of that company. Its intention of good faith toward its step-children, the Edison illuminating companies, now so explicitly declared, was never to be doubted.

The General Electric Company pronounces the suggestion that it had notified parties that if it did not get their orders for generating apparatus it would withhold lamps and other necessaries to be "entirely without foundation;" and says that in the present state of the lamp litigation "it is impossible to adopt a general policy applicable to all or to a majority of cases;" that it cannot announce a policy until it has formulated one. This denial is, of course, to be accepted. We fear, however, that some of the Company's agents or representatives, in the heat of competition for business, have been less reluctant to adopt a policy and have ventured the attempt to forestall the purchase of competing dynamos and other plant by threatening to shut off the supply of lamps. We are glad to be assured that nothing of this sort is sanctioned by the General Company. The allusion in the letter to the present situation of the lamp litigation is very significant. Judge Colt, in Boston, is considering whether a preliminary injunction shall be put upon the Beacon Company in view of the evidence of the alleged Goebel prior use brought forward by the defendants; while Judge Grosscup, in Chicago, announces his purpose, in his jurisdiction to see to it that users get lamps, if not from the Edison people then from the Sunbeam Company or from others. A decision in the Boston case, adverse to the complainants, would apparently at once clarify the present muddled situation and relieve users of incandescent lamps, and dealers in them, of all concern respecting the policy of the General Electric Company. The confessedly short term remaining to the Edison patent would probably expire before the Beacon case could be disposed of should it go to a final hearing without a preliminary injunction. No one can safely hazard a prediction as to whether the court will grant or withhold an injunction.

WAS GREEN A GOEBEL?

UP to the present time the electric railway field has been the scene of but little active legal warfare, as to patents, but indications are not wanting to show, that the present skirmishes may soon lead to a general engagement along the whole line. The consolidation of the Edison and Thomson-Houston railway interests has served to bring under single control a large number of patents relating to this important branch of work, but, as noted elsewhere in this issue, it would seem that the General Electric Company has deemed it expedient and necessary to further fortify itself for the struggle to come by the purchase of the Green patent. In viewing the present situation of affairs, there appears to be a striking analogy between the cases of Green and of Goebel. Both were intelligent dabblers in electricity long before either incandescent lighting or electric railroading became commercial actualities through the genius of other men, and both claim with much plausibility to have produced actual working devices embodying essentially the fundamental elements of the apparatus of to-day. It is true that in the case of Green a patent just beginning to run, was issued as the result of a prolonged interference in the patent office; but if, as is more than probable, a legal contest should be based on this patent, the General Company would find itself in the anomalous position of being a stout supporter of the claims of one inventor whose crude work was in many ways quite analogous to that of another, whom, they are now, and quite properly, strenuously opposing. It is a curious situation. The patent situation in the electric railway field bids fair to become quite as complicated as that of electric lighting in its palmiest days, as there is pending even now a suit based on the broad patent issued to Mr. Stephen D. Field, in which, as shown elsewhere, the employment of a dynamo electric generator is specifically claimed.

THE WORK OF THE PIONEER.

WHATEVER it may be in other fields, it is certainly true that in electricity the pioneer "never dies" from sight. Sooner or later his work is recognized and justice is done him. Our own pages have frequently contained the historical record of work that had been buried and wellnigh forgotten, and that awaited the careful search of the later investigator. At the present time when so much is being claimed and based, for purposes of legal offence and defence, on old work and old ideas, it is a pleasure to be able to print, solely for its personal and reminiscent value, to the interesting series of articles that Mr. W. J. Hammer has prepared for us on the pioneer electrical work of William Wallace. The wonder is that, having begun so early and so well, Mr. Wallace did not continue. As a matter of fact, he has kept pace with electrical growth, but he has not been the direct participator in it that one would expect on reading the really marvelous record that Mr. Hammer gives of his pioneer investigations and practical machines. It is a positive misfortune for the industry that so farsighted, able and wealthy a pioneer had other duties and interests. It must be evident to all that Mr. Wallace once held the dynamo industry in this country in the hollow of his hand. There is one great lesson in this narrative and in all the exciting events of the past few weeks, and that is, that it pays an electrical inventor to hold on and push on and then hold on again. In the lexicon of the electrical inventor, there must be no such words as "abandoned experiments."

THE INCANDESCENT LAMP LITIGATION.

THE interest in electric circles in respect to the outcome of the motion for injunction against the Beacon Company of Boston continues unabated. All the papers and exhibits in the case were submitted to the Court on February 1, and the case was then closed. We print in this number full abstracts of all the more important of the large mass of affidavits presented to the Court in behalf of and against the motion, together with illustrations of the two most important exhibits, and a synopsis of the proceedings at the supplementary hearing before Judge Colt, in Boston, on Wednesday last. From these articles our readers will be able to gain an accurate idea of the present aspect of this most remarkable case. At the time of going to press no decision has been reached, but it can scarcely be delayed more than a day or two longer at most. If the General Electric Company are entitled to an injunction, it is to be hoped it will be given them with all promptitude. The company and the electrical public will then have a clearer idea as to things.

THE THREE-WIRE PATENT SUSTAINED IN ENGLAND.

THAT legal struggles in the electrical field are by no means confined to our shores is evidenced by a recent decision given in England sustaining the validity of the three-wire constant potential system of distribution. This system, patented by Dr. John Hopkinson in England, was the subject of a suit brought by Dr. Hopkinson against the St. James and Pall Mall Electric Light Co. (Limited), of London, and the defence, it is interesting to note, was undertaken by an association of electric supply companies. Mr. Justice Romer in giving judgment in favor of Dr. Hopkinson, dwells mainly upon three points, namely, first, whether the patent in question was designed to cover the parallel system of distribution; second, whether it had been anticipated, and third, whether it embodied any patentable novelty, considering the state of the art at that time. On all these points the patent is sustained. Curiously enough, the Hopkinson three-wire patent in England is owned by the Westinghouse Company. In this country a suit to test the validity the Edison three-wire patent has been pending for some time and much of the testimony already introduced is similar in character to that brought out in the English case.

A METHOD OF CORRECTING THE REGULATION CURVES OF GENERATORS.

BY

Geo. L. Thayer.

One of the most serious difficulties met with in testing direct current dynamos is the difficulty of keeping the machine up to speed. When the design of new machines depends upon the results of a test it becomes very important to know just what the regulation is going to be, especially in the case of compound machines. The E. M. F. is by no means proportional to the speed in self-exited machines. The well known fact that compounded machines are very sensitive to variation in speed of the engine shows this. A variation in dynamo speed due to engine regulation and belt slippage of less than two per cent. will quite destroy the self-regulation of the machine.

In the case of separately excited and arc light machines the E. M. F. may be assumed to vary as the speed, and the curves from the machine may be connected accordingly. With a shunt machine this cannot be done. A change in speed in such a machine causes a change in E. M. F. considerably greater. This variation may be classed under two heads: First, that due to the change in speed, assuming the field to remain the same; and, second, that due to the increased strength of field due to the first change. Now if this ratio can be found, the E. M. F. of a machine can be computed accurately enough for all practical purposes, when the speed varies.

Call this ratio r.

Let $E =$ E. M. F., as observed;

" $E_1 =$ E. M. F., corrected for speed alone;

" $E_2 =$ E. M. F., corrected for speed and change in strength of field.

Let $T_w\ C =$ ampere turns in shunt coils as observed;

" n and $n_1 =$ observed and standard speeds, respectively.

From the magnetization curve in the region in which the E. M. F.'s will lie, find the ampere turns on the field necessary to produce a change of one volt. Call this value T. When working near the knee of the saturation curve the mean value for the probable range of E. M. F. should be taken. The new E. M. F. due to change in speed alone is

$$E_1 = \frac{n_1}{n} E.$$

The change in E. M. F. due to the change in field strength alone is, since the shunt field current varies as the impressed E. M. F.:

$$E_2 - E_1 = T_w\ C\ \frac{E_1 - E}{E} \times \frac{1}{T}.$$

By definition $r = \dfrac{E_2 - E_1}{E_1 - E}$.

Substituting and applying Ohm's law.

$$r = \frac{T_w\ C}{E \times T} = \frac{T_w}{R} \times \frac{1}{T}.$$

R is the resistance of the field plus the portion of the rheostat in use. As the temperature of the field changes the resistance, R is best computed from the observed values of E. M. F. and field current.

The E. M. F. corrected for speed and change in field excitation is then

$$E_2 = E_1 + r\,(E_1 - E).$$

But this does not take into account the change in field current in passing from E_1 to E_2. This further change in E. M. F. is evidently

$$r\,(E_2 - E_1) = r^2\,(E_1 - E).$$

This series of approximations may be continued, giving

$$E\ (\text{final}) = E_1 + (r + r^2 + r^3 + \text{etc.,})\ (E_1 - E).$$

This series is always a converging one and the equation then takes the form

$$E\,(\text{final}) = E_1 + \frac{r}{1 - r}\,(E_1 - E).$$

This value is an approximation but it is within the limits of errors of observation. The value of the series will run from 0.5 in machines with a large air gap, or working above the knee of the saturation curve, to 1.5 when the field is not saturated.

The value of the coefficient of $(E_1 - E)$ is a function of the number of ampere turns necessary to change the E. M. F. one volt. If the E. M. F.'s vary greatly and if the generator is working near the knee of the saturation curve, it may be necessary to compute more than one value.

A modification of this formula can be used in correcting the regulation curves of composite-wound alternate current generators; but where the composite winding is small the value of the coefficient is small.

This method has given good results in the plotting of regulation curves from large compound multipolar generators. In a few cases where steam had dropped just before the last points of the curve were taken the corrected E. M. F.'s resulted in a satisfactory curve although the drop in speed was almost 10 per cent.

ELECTRIC RAILWAY DEPARTMENT.

"TROLLEY WIRES NEED NOT HINDER FIREMEN."

BY

J. Stanford Brown.

In a recent number of a contemporary appears an article headed "Trolley Wires Hinder Firemen."

I am glad to see mention of this subject in the electrical papers because the appearance of such articles in the technical press refutes the statement so often ignorantly made that the "facts" and "faults" of the trolley system are not fully portrayed in the electrical journals.

An additional word on the subject should serve somewhat to allay the fears of those who still insist upon the "deadliness" of the trolley.

With a proper system of guys, etc., in line construction and a specially trained and equipped "Emergency Force," who are to be rung out together with the city fire department and the insurance patrol, no delay or extreme danger need be incurred by the firemen. Such a force must needs be maintained by all street railway companies operating a trolley system of any magnitude in our large cities. I do not think the city firemen should be either obliged, or permitted, to cut down wires at a fire. An experienced crew of six men with a speed-wagon and two or three extension ladders could "loop" the feeders around a batch of several buildings, drop the feeder cut-out into the gutter, and cut out the corresponding trolley and guard-wire sections in very close to as many seconds as it takes the firemen to get out their hose and couple up to the hydrants with pressure through their engines.

Of course the potential drop on that section might be increased for the time being, for the temporary wraps would not be soldered and the cars would be thrown slightly off their schedule. With a supply of "hose jumpers," however, and an amicable understanding between firemen and the emergency gang, but few lines would cross tracks; and the cars being within "police lines" could be safely shot across the break in the trolley wire. The line superintendent would be on hand to direct, and together with his foreman, should be a "special officer." This would ensure respect from citizens getting in the way before the arrival of police reserves.

In short, while there is a chance for some annoyance from wire in cases of fire, there is still a way of reducing it to reasonable bounds and it only remains to be determined by the demands of public convenience and safety what shall be considered reasonable bounds—for *the trolley is here to stay.*

THE ACQUISITION OF THE GREEN ELECTRIC RAILWAY PATENTS BY THE GENERAL ELECTRIC COMPANY.

THE announcement that the General Electric Company has acquired the patents on electric railways issued to George F. Green, and claimed to control vital features in this method of propulsion, adds an additional interest to the existing state of electrical affairs.

Green, it would appear, was one of those mechanics of whom this country has furnished many conspicuous examples, who dabbled in electricity and got up numerous devices having in view the application of electricity to the propulsion of vehicles. At the age of 21 he went to Kalamazoo, Mich., and opened a small machinist's shop. In 1856 he occupied a small room in the corner of the post office building in that city, where he operated some small electric motors of his own construction by means of batteries. He went so far even as to build a small circular track, upon which ran a small car driven by electric motors. The wires from the battery were connected to the rails, the positive pole to one rail and the negative to the other. He also stated that during that time a magneto generator came into his possession, the current of which he rectified and by which he operated the car on his track.

In 1865 he removed to another shop and was occupied largely in building electric appliances for operating dental instruments, sewing machines, and also continued work on his electric railway. The latter was frequently exhibited to people with the object of inducing them to assist him further in raising the money necessary to put up a large track with cars on it, and for the purchase of a dynamo in place of battery, which he recognized to be impracticable for heavy work.

About 1875 Green succeeded in raising capital sufficient to put up on the grounds where his shop was located in Kalamazoo, an elevated track a little over 200 feet long, the rails of which consisted of strap iron nailed to stringers of seasoned wood. These stringers were some five inches apart connected with cross pieces. The rails were connected to a battery on the inside of the shop, the end of the track coming up to the window of the shop.

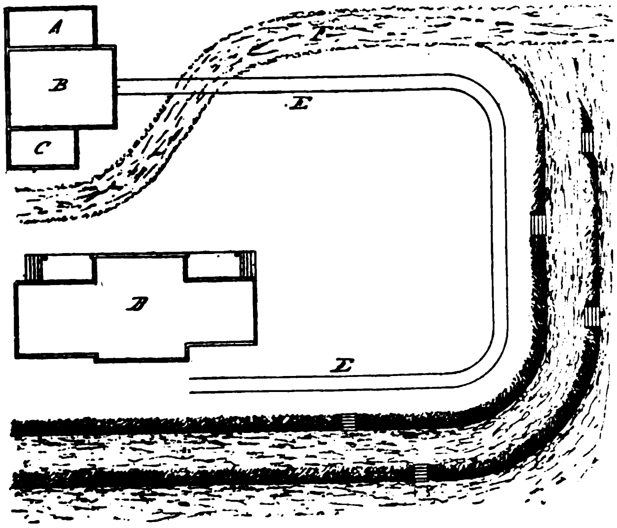


FIG. 1.—DIAGRAM OF GREEN'S ELECTRIC RAILWAY TRACK, 1875.

The accompanying diagram, Fig. 1, shows the location of the track; B being the shop, and E E the track. The arrangement of the circuits was such that the current passed from one pole of the battery to one rail, through the wheels to the motor, and then passed out through the other wheels into the opposite track and back to the other pole of the battery.

This car, according to the sworn statement of Mr. Green, had a reversing device that was capable of three positions, two for reversing and one for breaking the circuit. As the car ran out of the shop window down quite a steep grade it reached a level portion of the track, and at the distant end the reversing lever would strike a finger on the track rail that would reverse the car and send it back again to the shop window. This car was able to carry a load of about 100 pounds.

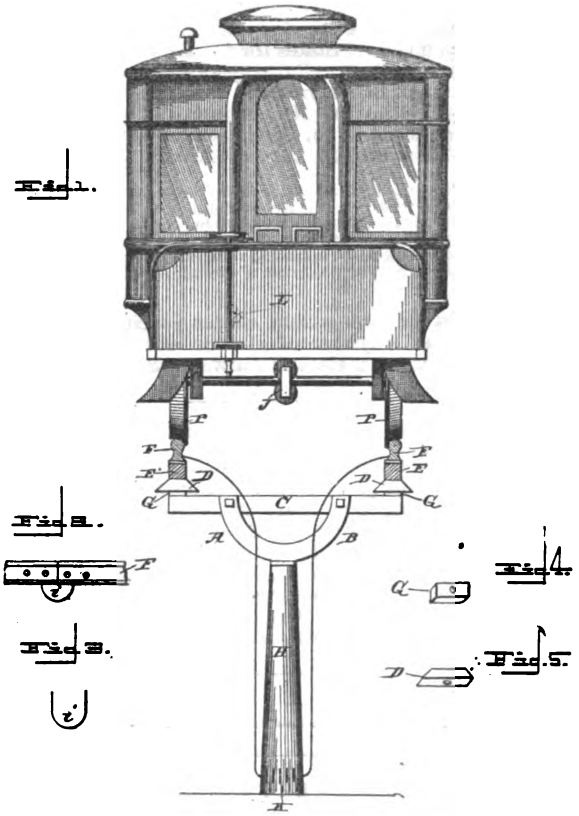


FIG. 2.—DRAWINGS OF GREEN'S ELECTRIC RAILWAY PATENTS, No. 465,407.

It may be mentioned here that the *Kalamazoo Daily Telegraph* of Oct. 7, 1875, contained an editorial entitled "Rapid Transit in Kalamazoo," which makes mention of Green's railway and suggests its application to the existing needs for rapid transit in New York.

Shortly after the completion of this small car, Green built what he termed a "flat car," with a platform about 6 feet long and 4 feet wide. This was also provided with a reversing switch and a safety device for preventing the car from starting off accidentally. This car had four electric motors attached by gears to the same axle.

During all this time Green declared he was making efforts to secure a dynamo, and states that he actually went with one of his financial backers to the Western Electric Works at Chicago, and operated his motors by current derived from a dynamo electric machine in operation at those works, in order to demonstrate the increased power of such machines over batteries.

On Sept. 15, 1879, Green applied for a patent which, after much delay in the Patent Office, caused by interferences, was issued on Dec. 15, 1891, No. 465,407, entitled "Electric Railway." This patent, the drawings of which we reproduce in the accompanying engraving, Fig. 2, has four claims, the scope of which will be seen by a perusal of claim 3 which reads as follows:

> 3. The combination, substantially as set forth, of a railway track, one or more stationary means of electric supply, electrical conductors extending from said means of electric supply along the lines of said track, and consisting wholly or in part of the rails thereof, vehicles movable along said track, electrodynamic motors fixed upon said vehicles for imparting motion thereto, and wheels supporting said vehicles upon the track, and also serving to maintain continuous electrical connection between said means of electric supply and said motors, substantially as described.

As was remarked above, Green employed a reversing device on his car, and the scope of his claim in this direction can be gathered from the first claim of the patent issued to him, entitled "Electric Railway," No. 465,432. This patent was filed May 15, 1886, and issued Dec. 15, 1891. The claim reads as follows:

> 1. The combination of one or more stationary sources of electrical current, a conducting circuit formed wholly or in part of an insulated line of rails of a railway track, a wheeled vehicle movable upon or along said line of rails, one or more rotating electric dynamic motors mounted upon said vehicle for propelling

> the same and included in said circuit of conductors, and a circuit-controller placed on said vehicle and also included in said line of conductors, substantially as described.

For a long time prior to his death, which occurred last year, Green was aided financially by Mr. Oliver S. Kelley, of Springfield, O., and to whom both these patents were assigned. The acquisition of these patents by the General Electric Co. is claimed by them to put them in a position to control all electric railways operated by the trolley system and handled by means of controllers on the cars.

We may add here, however, that a suit is now pending in the Circuit Court of the United States for the Eastern District of New York, brought by the Electric Railway Co. of the United States against the Jamaica & Brooklyn Road Co. The former are the owners of the patent issued to Mr. Stephen D. Field, July 16, 1889, No. 407,188, and application for which was filed on Mar. 10, 1880. The first claim of this patent reads as follows:

> 1. The combination, substantially as hereinbefore set forth, of a stationary dynamo-electric generator driven by a suitable motor, a circuit of conductors composed in part of an insulated or detached section of the line of rails of a railway track, a wheeled vehicle movable upon or along said insulated section of track, an electro-magnetic motor mounted upon said vehicle for propelling the same and included in said circuit of conductors, and a circuit-controlling device placed upon said vehicle.

It will be noted that this patent claims specifically a dynamo electric generator as a source of electric energy, and hence its owners claim that existing electric railways are subject to it.

A TROLLEY LINE FOR THREE COUNTIES.

A tri-county electric trolley line will be constructed in the spring from Middleburg, Pa., to Watsontown via New Berlin, Centreville, Mifflinburg, Lewisburg and Milton—a distance of 35 miles. Ex-United States Senator, John J. Patterson, of North Carolina, is at the head of the enterprise. The directors of the company are State Senator W. H. Hackenburg, of Milton, S. M. Patterson, of Mifflinburg; Representative B. K. Focht and Register and Recorder H. E. Gutelius, of Lewisburg, Pa. The route has already been surveyed and a charter applied for.

MISCELLANEOUS.

THE BENEFITS OF ELECTRICITY IN MINING.

BY

John McGhie

THE special advantages attendant upon the use of electricity in mining operations of all kinds are never more strikingly shown than during the prevalence of weather such as that to which we have been treated since the beginning of this winter. The temperature has fallen so low in certain parts as to render even the "oldest inhabitant,"—that unimpeachable authority,—incredulous as to the occurence of a severer winter in any of his previous experience. The snowfalls have been unprecedented in their persistency, the ice has accumulated in thicker strata and greater quantity, and what little sporadic thaws have supervened have caused unexpected havoc.

Reports from the mining districts of the less-favored territories show that although mining operations have been beset with great difficulties, yet in all cases in which electricity is the motive power used for the operation of the mine machinery, there has not been an instance of a breakdown; whereas, in former times and under less favorable conditions and methods, breakdowns were a usual occurrence in winter.

Mines operated by steam are subjected to many and various accidents directly traceable to sudden changes in temperature, each one of which is the cause of pecuniary loss to the mine owners and endless trouble and annoyance to the superintendent and his aides. Owners and managers wedded by predilection, or necessity, to the ideas which the progress in scientific knowledge of the last 10 years has relegated to the dusky obsolete, have been compelled to see water pipes burst, pumps choked by ice, boilers disabled, steam pipes damaged, ventilators stopped, stamping and concentrating machinery at rest, and the whole busy, restless life of the mine with its noisy hum, under the pall of a depressing winter silence, which lasts until the more genial warmth of spring arrives to assure the manager that he may begin to effect the necessary repairs without fear of further mishap. If the mine is the property of a company, the shareholders grumble at the loss of time and the non-productiveness of the mine, while the directors are at their wits' end to find rational excuses for the satisfaction of the shareholders.

But a compulsory shut-down of this character at the most inclement season of the year, has effects which reach farther than the pockets of the shareholders or the minds of the directors. Miners thrown out of work are unable to provide for those dependent on them, and wide-spread misery is the result. To forestall this, they are compelled by dire necessity to migrate to other points where subsistence for them and their families can be procured. If, however, the mine owners decide to keep their good men on the pay-roll, the expense entailed constitutes another addition to the already considerable loss brought about by the mere shut-down itself and the consequent non-production, during the season of inanition. If the miners are simply laid off, and migrate, the mine owners are always exposed, on the resumption of work, to the danger of having their mine filled with inexperienced workers and to the possibility of accidents with their ensuing loss.

Thus, suffering in some shape or another is inflicted upon all concerned once winter firmly grasps with icy hand the mine which is operated solely by water and steam;—upon the proprietors or shareholders in their most tender spots, their pockets; upon the miners, their wives and children, the future generation of workers, in their very lives. To these last the playful snowflake and the hoar-frost are realities which few of the shareholders of the ordinary category are able to conceive of, or, if so, to appreciate.

The adaptation of the electrical current to almost all the different methods of mining, and its more general adoption as progressive *fin de siècle* ideas permeate the body social, is effecting a gradual change in mine life which is assuming an aspect so different from what previously prevailed as to astonish those who do not keep well abreast of the swiftly advancing *Zeitgeist*. A stupendous reform is being effected, and the agent thereof is silently, but irresistibly, doing the work. The humble little wire, which runs over porcelain insulators, down into the bowels of the mine, to the points of application of the power, is, to use a celticism, a "fairy godmother." To the mine pervaded by the electrical current come no shut-downs. Bursted pipes are unknown; the whirr of the machinery is ceaseless; there are no stifled pumps. The course of mining operation runs its even way without delay or mishap. The throbbing pump at the extreme end of some deep working thrusts the water to the surface with constantly maintained force; the ventilators continue to supply fresh air, and draw off the deleterious; the cutter tears out without interruption the slot in the coal ledge; the drill merrily pounds its way into the depths of the mineral; the locomotive performs its alloted task, the cage ascends and descends without intermission; and the stamping mill and the concentrator continue their work uninterruptedly. There is no cessation of labor either of man or machine, except at the proper times. Temperature vagaries are indifferent matters of no particular concern either to miners or owners.

The results of an electrical installation in a mine, whatsoever be its character, are immediate and beneficial. Constant work means assurance for the owners and the men, and their minds free from the worry entailed by the ever present dread of a possible shut-down; they are able to think of improvements in operation and even occasionally to consider favorably the pleasing prospect of profits. The physique of the men also improves as the conditions under which they work are ameliorated, and it is incontrovertible that the better the physique, the better the class of labor, and the greater the material results. With the advent of profits, comes the contentment of the shareholders and directors, and, this last assured, the circle of benefit is complete.

From all that precedes a moral can be drawn by those who have ears to hear and eyes to see and recognise benefits when thrust within the range of their vision. Adopt electricity in all mines where possible, and reap the advantages which will as certainly result, as will the sun rise at the break of day.

MR. HARTER ON TRUSTS.

MR. MICHAEL D. HARTER, the Ohio M. C., was recently asked what had become of his anti-trust bill.

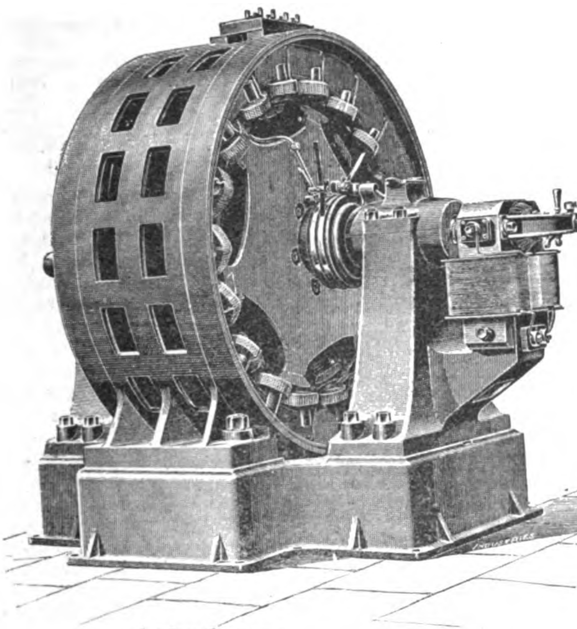
"I think it will become a law some time," he replied, "but I cannot say that it will this session. It is likely to be passed by both houses early in the next session, I think. It is, and ought to be, a stringent measure. We have now one law which aims in some respect to be so, but is has turned out to be a law showing 'how not to do it.' My bill, I think, is very fair and just. If the trust interested chooses to dissolve, it in no way punishes or seeks to punish past offenses. If not, it simply puts the articles made by the trust on the free list, and by way of a penalty strictly annuls all patents exclusively owned by the trust and deprives the trust of all its exclusive rights—in fact, of about all its advantages of good-will, trade marks, etc."

"Will it wipe out trusts?" was asked.

"You can imagine how much of a trust the Sugar Trust would be with from $12,000,000 to $15,000,000 cut out of it and restored to the people each year. What would happen to the Whiskey Trust, with the tariff tax cut down from $2.50 per gallon to the internal revenue tax of 90 cents? Where would the Cigarette Trust go with its patents annulled and its trade marks made public property? I intend to add to the bill, before its passage, the loss of trade marks. As the trusts can escape all these penalties by simply dissolving, it looks to a man up a tree as if the reign of the trust is likely to be only a question of time, and not a very long time, either."

TRIPLE-CURRENT ALTERNATOR.[1]

THE MASCHINEN FABRIK OERLIKON have recently carried out an interesting installation in the town of Pergine, in Southern Tyrol. The generating station is about two miles from the area of supply, and contains a high-speed turbine, with a horizontal axis running at 600 revolutions per minute, and coupled direct to a 100 h. p. triple-current alternator. As the distance over which the power has to be transmitted is small, step-up-and-down transformers are unnecessary, and a pressure of 1,700 volts is used. The generator, which was designed by Mr. E. Kolben, is shown in the accompanying illustration. The field magnet, which rotates, is of cast steel, having 12 poles, excited by a single coil, as usual in the Oerlikon multiple-current machines. Laminated pole-pieces are employed. They are built up of sheet iron stampings and fixed to the cast-steel pole-pieces. The external stationary armature has 18 coils wound in notches of a peculiar shape, coupled up in three sets of six coils each, and the exciter is coupled direct.


OERLIKON TRIPLE CURRENT ALTERNATOR.

The machine regulates within five per cent. without any series excitation, which is an exceedingly good performance. The excitation at full load is 1.1 per cent. of the out-put. Owing to the shape of the pole-pieces, and of the armature notches, the machine hardly hums at all. The total weight of the machine is three tons.

ELECTRICAL RECORDING METERS.—III.

BY CARYL D. HASKINS.

(Concluded.)

There is one other class of clock meter which actuates a dial or recording train, and for the typical instrument of this class we will select the Pilkington-White meter. This instrument has a wheel rotating at a constant speed; into this wheel are inserted a number of pins of different lengths, projected from the face of the wheel parallel to its axis; a lever arm whose position is determined by the indicator mechanism is so placed that it shall engage with these pins. If the load be light it will only engage with the longest pins. If, for example, the load be one lamp, then the lever will engage only with the longest pin. On engaging with the pin, the lever is pushed in the direction in which the wheel is rotating, and gives an impulse of one tooth to the recording wheel. Thus, on the light loads the meter would receive but one impulse for every revolution of the motor wheel, and just in proportion as the load increased, so this lever would engage with more pins and more frequently actuate the recording dial.

This meter is very good in many respects; but it should be noted that it reads to points. There is necessarily a limit to the number of pins which can be used, and with a 100-light meter, having, we will assume, 10 pins, it is clear that there can only be 10 variations in speed from one lamp to full load, consequently the speed will only change every 10 lamps, and we should get the same record on 19 lamps as on 10. The figures which I give for a 100-light meter and 10 pins, are purely arbitrary and not representative of the number used, but are given to indicate the idea which I wish to convey.

We may now turn from the consideration of the clock and separate motor meters, and give our attention to what is to-day the most important class of electrical recording instruments, the motor meters, or those whose registering train is actuated by the current to be measured. There are quite a large number of meters of this class, although invention until recently has not been as prolific in this particular direction as in the clock meter field. In the majority of cases, motor meters have been designed for alternating circuits, and these again naturally divide themselves into two classes, those actuated by inductive principles, and those whose motive powers act direct, and which are similar in character to the electric motor. Of the first class there is a large number, designed, of course, for alternating circuits.

These are almost exclusively of two forms—the wound and the unwound armature types. But few, if any, of the former are in practical use, though several have, I believe, shown very fair results. As a rule, they consist of a field formed of a coil or coils in series with the lamps, and a small drum, or other closed circuit armature, preferably without iron, whose commutator is short-circuited across, by directly connected brushes, or other similar means. This meter will record with considerable accuracy, but in the presence of better and simpler plans, it has not met with general favor.

The other class of inductive meters is, in its various forms very familiar to almost every one. It consists, in general, of a coil or coils, in series with the lamps forming the primary. A short-circuited coil of low resistance within and at angle to this, forms the secondary, and within this again is a more or less solid metal armature of disc, drum or other shape, generally wholly or in part of iron, and mounted on a carefully balanced shaft, which, on rotating, actuates the recording dial.

Meters of this construction while highly practical and decidedly useful, are scarcely all that could be desired for several reasons, all of which tend to introduce errors. In the first place their construction and principle prohibit entire accuracy on very low readings. This is quite largely due to the fact that nothing is present to balance friction.

Now the theory of meters as set forth in most of the patents on file, claims a torque proportional to the square of the current, which doubtless would be correct, could we neglect the effect of certain minor influences. In reality, careful tests seem to show that torque falls somewhat below the square, and above the direct proportion, and the proportion does not seem to hold good at various points of load. The speed of motor meters is naturally approximately proportional to the torque, and they therefore tend to run too fast and have to be restrained, which is accomplished in various ways, as we shall presently see, while discussing the question of drag or damping mechanism. None of the inductive meters will run on direct current, of course.

We now come to the second form of motor meters—those which are not dependent upon inductive action for their rotation, and are consequently equally serviceable for alternating or direct circuits. Of these there are but a few, all of them having a field in series with the lamps and an armature—sometimes in series and sometimes in shunt. Of the former kind but few have been tried carefully enough to thoroughly prove their merits.

Perhaps the most successful of these has a heavy iron field, with resultant poles above and below a shallow basin of mercury. The current for the lamps passes through a copper coil around, and excites, the field, thence through the mercury from a portion of its periphery to centre or *vice versa*. This naturally causes the mercury to rotate, its speed being proportional to the amount of current, minus, of course, the effect of friction, the mercury in this case forming the armature. Friction is balanced in this meter quite successfully by the introduction of a fine coil of high resistance around the field. This coil is "in shunt across the line," and serves to intensify the field on the lower readings, while on the higher ones it bears too small a proportion to the total field to exert any appreciable influence. This coil can be nicely adjusted to balance friction, by varying an outside resistance. While such a meter has many weak points, still it has one marked advantage, the balancing of friction. This cannot be given too great importance in motor meters, for friction is their weakest point, and by successfully neutralizing this, they may be brought to almost any degree of accuracy, provided always that their fundamentals remain proportional throughout.

The remaining class of motor meters embraces those with a

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[1] *Industries.*

series field and shunt armature. These are somewhat of a departure from the others, since they are not current meters, but power or watt-meters. Their construction is in all cases quite similar to an ordinary shunt motor, the conditions of field and armature being reversed. The field is in series with the lamps; the armature, which is of high resistance, and generally of Siemens construction, with a commutator of a few segments, is placed "in shunt across the line," the shunt being taken off beyond the field coils. An outside resistance is placed in this shunt circuit, to reduce the current in the armature to the necessary small quantity and to prevent any appreciable waste across the line.

The strength of armature then, may be seen to be dependent on the pressure, whilst that of the field depends on the expenditure of current. The torque of this meter then, is directly proportional to the power passing, and the speed is naturally proportional to the torque (again minus the friction) but the friction is balanced in these meters, as in the previous one, by the presence of a "shunt field," since the armature circuit is taken off beyond the fields, and consequently passes through them in addition to the current for the lamps. As in the previous meter this serves to counteract the retarding influence of friction in the lower readings where it is dangerous, whilst in the higher ones it bears so small a proportion to the total field as to be inappreciable. This meter is, of course, equally useful without change of calibration on either a direct or an alternating current of any frequency.

Motor meters, as a class, rotate far more rapidly than is allowable in practice. It has been found necessary, therefore, to introduce a "drag," or resistance to rotation, to slow the meter to a reasonable speed. This has been done in several ways; perhaps the most common method being to attach to the shaft a number of air fans. These are quite largely used, and with fair success. The resistance of an air fan to rotation is approximately proportional to the square of the speed. Therefore this device is only fitted for combination with such meters as have a torque increasing with the square of the current. But since the torque of such meters does not quite reach the square, the retarding effect increases rather too rapidly, and has a tendency, though not always pronounced, to cause the speed of the meter to fall off proportionately on high loads. An effort has been made to overcome this disproportion of the fan's resistance by substituting folding fans which close by centrifugal force, on the principle of the steam-engine governor. This novel idea, whilst a decided improvement, scarcely overcomes the difficulty.

Another method of drag, which has been used with some success is the rotation of a small fan in a liquid, a method perhaps rather better than the previous one, since resistance to rotation falls below the square of the speed, when the liquid itself begins to rotate. Much depends in this case on the shape of the receptacle containing the fluid.

A third method, certainly by far the best, consists in rotating a small inefficient dynamo, generally a mere disk, turning between permanent or electromagnets. This resistance is of course directly proportional to the speed, and therefore to the torque, being indeed the machine reversed. By applying this drag, friction is again the only difficulty to contend with.

One other important point in connection with the drag and the friction we must not neglect. The greater the drag (commensurate, of course, with sufficient speed), the smaller the proportion of friction to the total load will be, and the greater the accuracy of the instrument's registration.

To sum up then, it would seem that the most practical and useful meter, according to our present light, would be a motor meter of other than inductive type—preferable an energy rather than a current meter—with some force to balance friction, with a drag which is directly proportional to the speed, and which will be comparatively heavy, making the irregular friction as small a portion of the load as possible. With all these features properly worked out and applied there can be no reason why a meter should not be accurate, efficient, comparatively cheap, and thoroughly able to take care of itself without undue attention.

There is another form of motor meter somewhat akin to the clock meters, which we discussed above. This comprises those instruments whose motor would rotate at a constant speed, provided the resistance to rotation were also constant. In other words, the current passing through the meter would be so arranged as not to cause fluctuations of speed in the motor directly. This is easily accomplished by placing the motor in shunt across the line like a lamp, and properly proportioning its windings. Variation in speed of the motor which is geared directly to the dial, is accomplished in this class of meters by varying the resistance to rotation or drag.

"HEATING AND VENTILATION."

We have received the first number of this new monthly, dated Jan. 15. It is very tastefully printed, and abounds in excellent reading, well illustrated, on the subjects within its province. A large number of advertisers also evince good judgment by patronizing the paper.

SOME OBSERVATIONS UPON THE CONDUCTIVITY OF A COPPER WIRE IN VARIOUS DIELECTRICS.[1]

BY FERNANDO SANFORD, M. S.

The author gives the results of an investigation of the influence upon the electric resistance of a conductor as dependent upon the dielectric surrounding it. For this purpose the investigator employed a cylindrical copper tube 120 centimetres long and 2.5 centimetres in internal diameter. Within this tube which was closed air tight by copper plates, a copper wire one millimetre in diameter was passed lengthwise through the centre. Stop-cocks were provided for filling and emptying the tube of different liquids, gases and vapors. Arrangements had also been provided for measuring the temperature of the tube. The wire was in circuit with a Wheatstone bridge and the current was passed one way through the tube and returned through the wire. In this way the entire field of force of the current was confined within the tube.

Taking the conductivity of the wire in air as unity the conductivity in the liquids examined were as follows:

Petroleum	1.0018
Carbon Bi-Sulphide and Oil of Turpentine	1.0009
Carbon Bi-Sulphide, uncertain, apparently	1 +
Wood Alcohol	.9998
Benzine	.9994
Wood Alcohol and Benzine	.9985
Absolute Alcohol	.9981
Wood Alcohol and Petroleum	.9973
Distilled Water, uncertain, apparently	1.—

Tests made with the tube filled with various gases, gave the following results:

Alcohol Vapor	.99949
Chloroform Vapor	.99830
Gasoline Burning Gas	.99820
Sulphuric Ether Vapor	.99750
Carbon Bi-Sulphide Vapor, approx	1.
Rarefied Air less than	1.

Prof. Sanford points out that the above order corresponds with that of the refractive indices of the respective gases and vapors with the exception of the carbon bi-sulphide vapor; but he points out that no value should be attached to this comparison for the reason that the vapors are mixed with air, and their density was perhaps very different from that at which their refractive indices are determined.

EXPERIMENTS IN ELECTRIC AND MAGNETIC FIELDS, CONSTANT AND VARYING.[2]

At the meeting of the Physical Society, held on November 25, 1892, Professor S. P. Thompson, D.Sc., F.R.S., Vice-President, in the chair, the following communication was made by Messrs. Rimington and Wythe Smith: In the first set of experiments shown, exhausted electrodeless tubes and bulbs were rotated rapidly in a constant electric field between two parallel charged discs. Double fan-shaped images were produced by the tubes, due to the displacement currents which pass to equalize the potentials at the end of the tubes. These fans were not symmetrical with respect to the lines of electric force, but were displaced in the direction of rotation. In explanation of this phenomenon it was pointed out that as a tube rotated, the potential difference between its ends increased until this difference was sufficient to break down the dielectric in the tube. The discharges would, therefore, pass at the ends of the intervals, during which the difference of potential was rising, and consequently the images would be displaced from the symmetrical position in the direction of rotation. The number of discharges produced during one revolution was found to depend on the strength of the electric field, but not on the speed of rotation, and that end of the tube which was approaching the negatively charged plate appeared brightest. These experiments were referred to as examples of the direct conversion of mechanical energy into light.

Instead of rotating tubes in a constant electric field, the tubes were next kept stationary, and a varying electric field produced by connecting the plates with an influence machine allowed to spark; under these conditions the tubes and bulbs were seen to glow.

Using large suspended plates charged by an induction coil, long tubes were caused to glow brightly, even at considerable distances away from the plates. The glow could be apparently wiped out by passing the hand along the tube.

Another series of experiments were performed in varying magnetic fields. With a view to showing Hertzian phenomena to large audiences, the authors tried Geissler tubes to replace the spark-gap in resonators with great success. When large Leyden jar circuits were used, the effects were very brilliant. Another form of resonator consisted of a bent wire terminating in two plates between which an exhausted tube was placed. This tube

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1. *Leland Stanford, Junior, Univ. Publications.* Studies in Electricity, No. 1. Abstract.

2. *Engineering.*

became luminous when the resonator was placed in the vicinity of a fairly large Hertz oscillator.

Other experiments similar to those shown before the Society at Cambridge by Professor J. Thomson on discharges in exhausted bulbs were then made, the bulbs being placed with a coil of wire of four turns forming the connection between the outer coatings of two small jars, whilst sparks passed between knobs connected with the inner coatings. The bulbs glowed brightly at each discharge, rings of light being seen near their inner surfaces. On putting a ring tube outside the coil this was also seen to glow. The most brilliant part of the glow always occurred in close proximity to the wire coil.

A secondary coil wound by the side of the above-mentioned primary, could be short-circuited at will; this had the effect of decreasing or extinguishing the luminosity in the bulb or tube. Bright sparks passed between the secondary terminals when held a short distance apart, but the shock experienced by touching the ends was not serious.

The above arrangement, with the addition of two Geissler tubes placed in series between the outer coatings of the jars, was used to illustrate the fact that closing the secondary diminishes the impedance of the primary circuit of a transformer.

Experiments on condensers made of tinfoil on glass were shown. In one of them, parts of the coatings, in the form of letters had been removed, and the spaces became luminous when the condenser was connected with an induction coil. In another experiment a glass plate was moved to and from a condenser, and a musical note could be heard, whose pitch increased as the distance between the glass plates diminished. The note was said to be the octave of an open organ pipe whose length was equal to the distance between the plates.

SECOND CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION AT TORONTO, JANUARY 25 AND 26, 1893.

The second convention was opened at the School of Practical Science at 2 p. m., January 25, by President J. J. Wright who delivered his address, in which, after referring to the rapid strides being made in the application of electricity as a motive power for street railways in Canada and to the prosperous condition of the electrical industries, he cautioned the members against being led astray by visionary schemes which were springing up like mushrooms. Their inevitable failure would bring discredit to a certain extent on legitimate enterprise and profitable business. During the half year just passed there had not been many new developments in the application of electricity. Effort appeared to have been directed to perfecting known appliances and inventions, in which much progress had been made, especially in the improvement of street railway apparatus. New departures were noticeable in the engineering branch. The vertical type of large engine had entered the field, and was there to stay. In electric generators, large units were also growing in favor.

He recommended for consideration the appointment of subsections to deal with details that were beyond the scope of the Association as a whole, as, for example, the question of fuel supply. In Ontario and the greater portion of Canada coal has to be imported. United action on the part of the operators of central stations, which would establish direct communication with the miners of coal, might result in a considerable saving in the cost of fuel. Electrical men were also interested in the question of railway charges and it had been suggested that the Association should endeavor to have the classification of electrical apparatus modified so as to reduce the high rates of freight charged on some kinds of electrical material. In conclusion the President commented with satisfaction upon the progress being made in telephony throughout Canada and also referred to the recent developments of scientific research.

Prof. Rosebrugh then addressed the convention, welcoming the members to Toronto on behalf of the School of Practical Science.

Mr. C. H. Mortimer, the secretary-treasurer, next presented his report for the past six months. It showed that the affairs of the Association were in a prosperous condition. The receipts amounted to $468.24 and after paying all expenses there was a balance on hand of $208.18. Since the last convention eleven members had joined the Association, making the total membership 119.

The Committee on Statistics, which had been appointed at the last convention to collect statistics of the electrical industries, asked for a grant of money to print sets of questions to be submitted to the telephone, telegraph and electric light and power companies. From the answers to these questions, statistics would be tabulated. The authority for a grant was given.

The first paper was by Mr. Geo. Black on "Electrical Measurement" and led to considerable discussion on the part of the members.

Mr. W. A. Tower then read a paper on "Underground Construction" in which he referred to what was being done in that line by the Bell Telephone Company in Toronto.

Mr. A. B. Smith, of the Great North-Western Telegraph Company, explained the use of motor generators by his company in place of chemical batteries.

After the close of the session, a number of the members visited, by invitation, the laboratories of the School of Practical Science, the station of the Toronto Incandescent Electric Light Company and that of the Toronto Electric Light Company. The evening was spent most enjoyably at an informal dinner given the members by the president and officers of the Association.

At the morning session, on Thursday, in the absence of the author, Mr. A. B. Smith read the paper of Mr. J. M. Campbell on "Free Wiring" in which the free wiring of premises for customers by electric light companies was strongly opposed.

Mr. R. G. Black then read an instructive paper on "The Incandescent Lamp."

The remainder of the morning session was devoted to the consideration of the proposition to divide the Association into sections representing the different branches of electrical industry. Those in favor of the change contended that by division into electric light, telephone and other sections, a much greater field would be covered in the same time and the interests of these different departments advanced. The majority of the members held, however, that such a division would not be conducive to the interests of the Association as a whole and it was decided to make no change for the present.

Upon re-assembling in the afternoon, Prof. Rosebrugh read a paper on "Speed Control" treating of the different methods of speed regulation and their advantages and disadvantages.

After, this Mr. E. C. Breithaupt read a paper on "The Probabilities as to the Success of the Distribution of Power at Considerable Distances by High-Tension Currents."

Before adjournment, it was decided to hold the following convention at Toronto during the month of September, next, the exact date to be fixed by the executive. A vote of thanks was passed to the Acting Minister of Education and the Faculty of the School of Applied Science for the use of the room in which the meetings were held. This brought to a close the second convention of the Association, which it was felt by all had been a most successful one as shown by the interest manifested in the different papers and the discussion they provoked.

After adjournment, the members visited the new Exchange of the Bell Telephone, Co., one of the finest on this continent, by invitation of that company.

Among the members in attendance were the following: J. J. Wright, Toronto; John Carroll, Montreal; C. H. Mortimer, Toronto; D. A. Starr, Montreal; H. O. Fisk, Peterboro; A. B. Smith, Toronto; D. Thomson, Hamilton; John Yule, Guelph; Thomas H. Wadland, Hamilton; L. B. McFarlane, Montreal; A. M. Wickens, Toronto; George Black, Hamilton; J. A. Baylis, Toronto; W. A. Tower, Toronto; R. G. Black, Hamilton; A. T. Smith, Kingston; B. J. Throop, Brantford; George M. Wright, Montreal; J. H. Greer, Peterboro; H. Beaumont, Toronto; J. W. Taylor, Peterboro; J. A. Kammerer, Montreal; George W. Sadler, Montreal; O. C. Armstrong, Toronto; W. Bourne, Toronto; H. S. Thornbury, Toronto; A. C. McCallum, Peterboro; W. J. Jones, Toronto; Hugh Neilson, Toronto; W. B. Evans, Toronto; W. J. Clarke, Toronto; R. F. Carter, Niagara Falls; Chas. B. Hunt, London; Alex. Stark, Toronto: John Langton, Peterboro; E. C. Breithaupt, Berlin; James P. McQuaide, National Conduit Company, New York; W. R. McLaughlin, New York,

PREPARATIONS AT ST. LOUIS FOR THE ELECTRIC LIGHT CONVENTION.

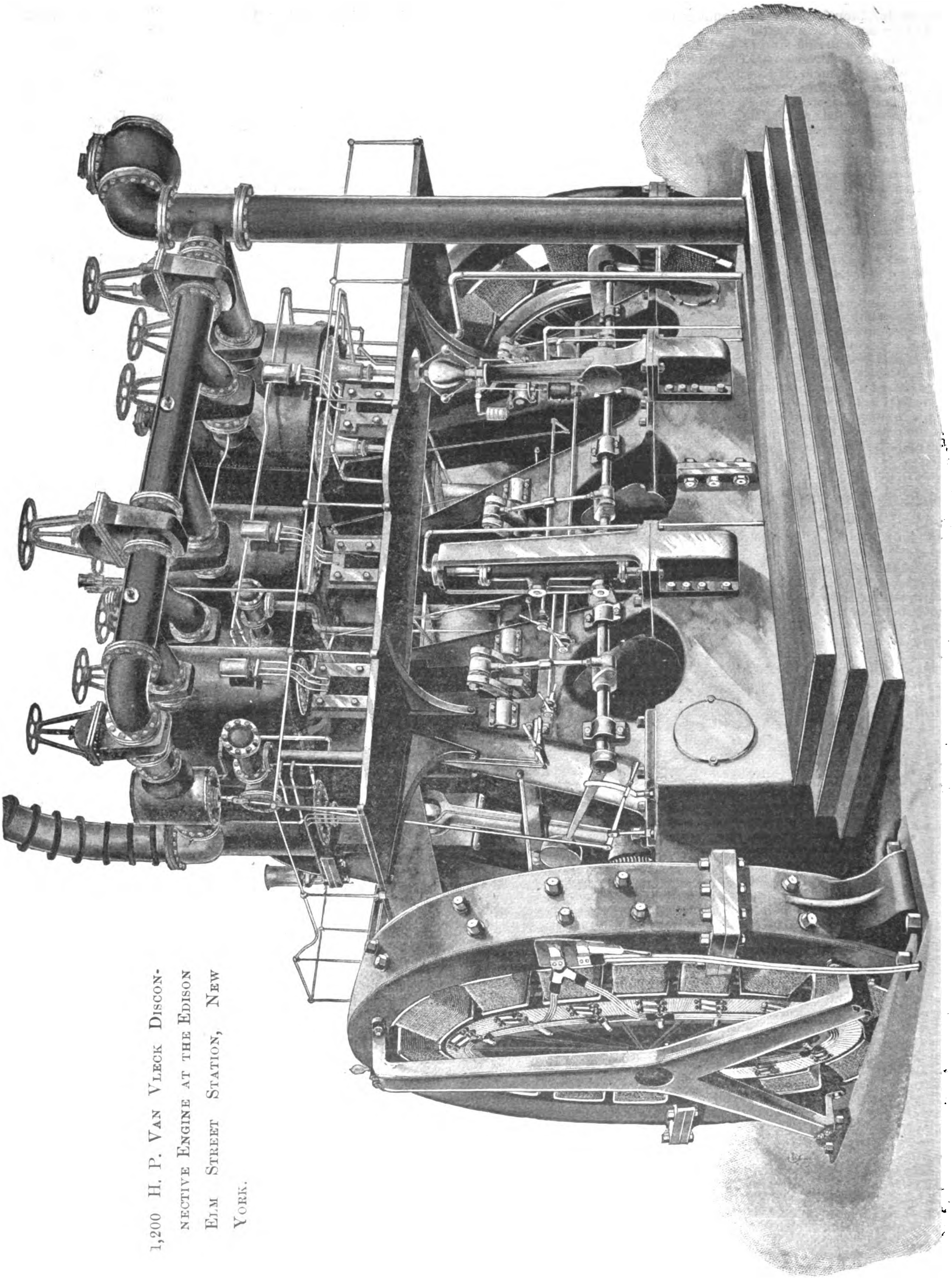
At a recent meeting of the St. Louis Electric Club, as mentioned in our columns last week, the question of entertainment for the National Electric Light Association was discussed. It was the general opinion of those present that no effort or money should be spared to make the event a memorable one and to entertain the 300 visitors expected in a royal manner.

Mr. J. A. J. Shultz was appointed chairman of the finance committee, and with him were associated James I. Ayer, E. D. W. Meier, Geo. P. Jones, T. M. Ambler, Louis Nahm, C. R. Scudder, Robert B. Annan, Marcus Bernheimer, John S. Moffitt, Frank R. O'Neill, F. J. Wade, L. D. Kingsland, Frank Shapleigh, Frank Gaiennie, Goodman King, Ben. Elseman, Douglas Cook, Ellis Wainwright, A. Siegel, S. G. Booker, John C. Wilkinson.

The executive committee was named as follows: Mr. Nahm, chairman; James I. Ayer, Frank Gaiennie, Nathan Frank and Goodman King.

COLD IRONY.

An Ottawa electrician claims to have discovered a process for utilizing electricity to abstract the heat from cast iron blocks until they are reduced to the temperature of ice, and then using them as a substitute for natural ice. He claims that this can be done at a price to compare favorably with the latter.



1,200 H. P. Van Vleck Disconnective Engine at the Edison Elm Street Station, New York.

1200 H. P. VAN VLECK DISCONNECTIVE ENGINE AT THE EDISON ELM STREET STATION, NEW YORK.

THE accompanying engraving represents the first of a pair of large engines which have been constructed for the Edison Electric Illuminating Company, of New York, by the Dickson Manufacturing Company, of Scranton, Pa. This engine is now completely erected and in running order at the Edison Elm street station, and is directly connected to multipolar dynamos. It is of the same type as the smaller triple engines which have been built for the company, and are now operating in the Twenty-sixth street station, and was designed from the specifications of Mr. John Van Vleck, with the assistance of Mr. J. W. Sargent. Valuable suggestions having been received from Mr. S. F. Prest, of London, England.

The engine is intended to develop 1,250 h. p. when running at best economy, although it can easily develop 1,500 h. p., should the occasion require it. The cylinders are 24, 35 and 52 inches in diameter, with a 36 inch stroke and speed of 100 revolutions per minute The shaft is of wrought iron and is 12 inches in diameter and is made in three sections in which the coupling forms a part of the crank blocks, thus saving the space ordinarily utilized by shaft couplings—a detail which has been very successfully applied by Mr. David Joy of England.

The steam chests are placed at the front of the cylinders, instead of between them, as is the common practice, and in this way as much as 30 per cent. of floor space is saved, which is a very important consideration where real estate is valuable. The engine is therefore only 19 feet 6 inches long over end bearings and is 12 feet wide at the base.

The piston heads and cylinder covers are of cast steel of the marine "coned" type, which not only makes these parts extra light and strong, but economizes in the height of the engine; it being only 19 feet 6 inches in extreme height from the bottom of the base.

The placing of the steam chests on the engine front, lends itself admirably to the employment of a system of disconnective piping, which makes it practicable to run the engine with any of its cylinders thrown out of gear, should any part of the engine need repair. The engine is therefore called a disconnective engine, to distinguish it from other types of multi-expansion engines, which would have to shut down completely should an accident happen to any cylinder or valve gear. The conditions under which an electric generating engine has to work are even more severe than in the case of marine engines, which usually have long intervals for making repairs in port; while an electrical generating engine, in a city like New York, has to run nearly all the time, so that a disconnective engine is considered to be a vital necessity for land work of this character.

The 1,250 h. p. engines will form a pair of the smaller engines for the Elm street station, as the regular unit will be a quadruple expansion engine of 2,500 h. p., to be built somewhat on the same plan as the smaller engines, with the important difference, that they are to be constructed on the two-crank tandem type instead of on the three-crank type as illustrated.

All the engines for the Elm street station are to be built for 210 pounds steam pressure and are to be amply strong to carry even higher pressure if necessary. The building of the two-crank quadruple engine enables the company to place twice as much generating capacity within the same area as could be obtained by employing three-crank triple-engines, which is a most desirable thing to do from a financial point of view. We are indepted to *Power* for the excellent illustration on the opposite page.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JANUARY 24, 1893.

Alarms and Signals :—

Electric Annunciator System, H. Van Hoevenbergh, New York, 490,327. Filed Mar. 24, 1892.

A visual annunciator in which electric lamps are employed to illuminate transparent numbers, letters and the like.

Electric Show Case Alarm, R. C. Kruschke, Duluth, Minn., 490,479. Filed July 9, 1892.

Railway Signal, I. L. Green, Kittanning, Pa., 429,626. Filed Jan. 9, 1892.

An electrically operated block signal.

Conductors, Conduits, and Insulators :—

Insulator, L. McCarthy, Boston, Mass., 490,302. Filed July 8, 1892.

Invention consists in replacing a portion of the sheet mica with flake mica pressed and compacted around the connecting piece.

Closed Conduits for Electric Railways, R. Parker & B. F. Sutton, Brooklyn, N. Y., 490,306. Filed Jan. 9, 1892.

Employs a flexible insulating tube, a main conductor within it, an interrupted conductor fixed to the tube opposite the main conductor, and combined clamping and supporting plates having jaws which partly embrace the main conductor exterior to the insulated tube.

Insulator, A. J. Hauty, Saltsburg, Pa., 490,560. Filed Aug. 29, 1892.

Employs an outer cap which screws down over the line-wire, holding it firmly in place without the necessity for tie wires.

Electric Conduit, E. L. Ransome, Oakland, Cal., 490,630. Filed Apr. 5, 1892.

A water conduit having passages for electric conduits formed within its walls in combination with a manhole and entrance chamber common to all.

Dynamos and Motors :—

Electric Motor, J. W. Hansen, St. Paul, Minn., 490,280. Filed Sept. 25, 1891.

Employs laterally adjustable stationary field magnets and a double concentric commutator, and adjustable commutator brushes mounted in one of the frame plates and making contact with the different faces of the commutator.

Armature for Dynamo Electric Machines or Motors, E. Thomson, Swampscott, Mass., 490,376. Filed July 10, 1891.

Employs a sectional laminated core having overlapping sections, holes through said sections near their inner edges, and binding rods occupying the holes.

Dynamo Electric Machine, R. Lundell, Brooklyn, N. Y., 490,449. Filed June 21, 1892.

Employs a single field magnet coil surrounding inwardly projecting poles, and a rotary armature whose axis is parallel with that of the field magnet coil.

Dynamo Electric Machine, C. Wachtel, Newark, N. J., 490,460. Filed June 13, 1892.

Employs a commutator consisting of porcelain sections having longitudinal slots, each section having an annular portion and an under-cut portion with insulated commutated sections between the annular portions.

Lamps and Appurtenances:—

Electric Lamp Socket and Tap. A. F. Vetter, New York, 490,605. Filed May 20, 1892.

Measurement :—

Electric Meter, O. Frölich, Berlin, Germany, 490,279. Filed Nov. 16, 1892.

An electric meter in which the counter registers the number of oscillations of a bar of soft iron subject to the influence of the current.

Miscellaneous :—

Locking Hat Rack, F. B. Trout, Detroit, Mich., 490,326. Filed June 13, 1892.

Electric Mat, W. G. James, Harlem, Ill., 490,353. Filed Sept. 29, 1892.

Electrical Musical Instrument, A. Montamellin, Portland, Ore., 490,358. Filed May 31, 1892.

Fountain, G. Trouvé, Paris, France, 490,378. Filed Sept. 30, 1891.

An electric illuminated fountain.

Support for Telegraph Cables, F. Le B. Bedwell, London, England, 490,584. Filed Sept. 26, 1891.

Apparatus for Distributing Mail, F. D'A Goold, New York, 490,607. Filed May 6, 1892.

Employs a driveway and a carriage movable along it containing articles in separate packages, and magnetic releasing devices by means of which the packages are dropped off at predetermined points.

Railways and Appliances :—

Electric Railway Conductor, H. A. Miner, New York, 490,297. Filed June 2, 1892.

Employs a feed wire suspended in contact with the trolley wire and serving both as a support and an electrical feeder for the latter, in combination with a case partly inclosing both wires.

Electric Locomotive, A. Philipsborn and M. Schiemann, Berlin, Germany, 490,307. Filed April 14, 1892.

Employs a motor movable relatively through the traction wheels and means for frictionally transmitting power from the motor to the wheel.

Elevated Railway System, C. Drill and H. J. Hutchinson, St. Louis, Mo., 490,549. Filed Feb. 18, 1892.

Claim 1 follows:

An electric air ship consisting of a carriage provided with a motor or motors, a balloon movable laterally independent of said carriage and connected therewith by a single flexible cable, and a car carried by the balloon and independent of the track along which the motor travels.

Conductor System for Electric Railways, R. Hayden, Fairmond, W. V., 490,597. Filed April 13, 1892.

Employs an insulated conductor, a contact conductor divided at intervals into sections normally disconnected from the insulated conductor and from each other, and means by which, at the time when the current collector passes off of a section preceding a given section, and on to the latter, the preceding section is disconnected from the insulated conductor and a succeeding section connected therewith.

Switches and Cut-Outs :—

Cut-Out for Electric Circuits, M. Leavy, Pittsfield, Mass., 490,292. Filed June 16, 1892.

Employs fuse strips enclosed in separate tubular cases readily insertible in the porcelain box without the use of tools.

Electric Switch, A. L. Rohrer, Lynn., Mass., 490,363. Filed March 17, 1892.

Employs switch arms each carrying one of the contacts and mechanically connected to the contact with a rotating supporting plate to which both arms are pivoted on a common axis.

Electrical Connecting Device, J. Hutchinson, New York, 490,477. Filed Sept. 16, 1892.

A combined safety cap and switch especially adapted for use on connecting blocks.

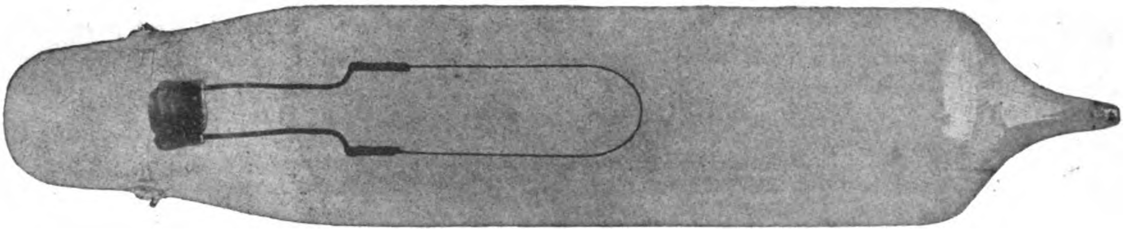
COLLEGE NOTES.

ELECTRICAL ENGINEERING AT COLUMBIA COLLEGE.

RECOGNIZING the increasing importance of the course of electrical engineering established at Columbia College in 1888, the trustees at a recent meeting decided to create an entirely independent department devoted to this branch of engineering. It is intended to still further increase the scope and facilities of this department, and thus to offer students a thoroughly comprehensive course of study. We are also gratified to learn that Prof. F. B. Crocker, whose conscientious work has contributed so much to the success of the electrical engineering course at Columbia, has been promoted to a full professorship, with charge of the new department.

CHAS. D. JENNEY, president of the Jenney Motor Company, of Indianapolis, was a recent Chicago visitor and called at the ELECTRICAL ENGINEER'S western office.

GOEBEL'S INCANDESCENT LAMP AND FILAMENT PLANER.



Alleged Goebel Carbon Filament Lamp, Said to Have Been Made Prior to 1872.

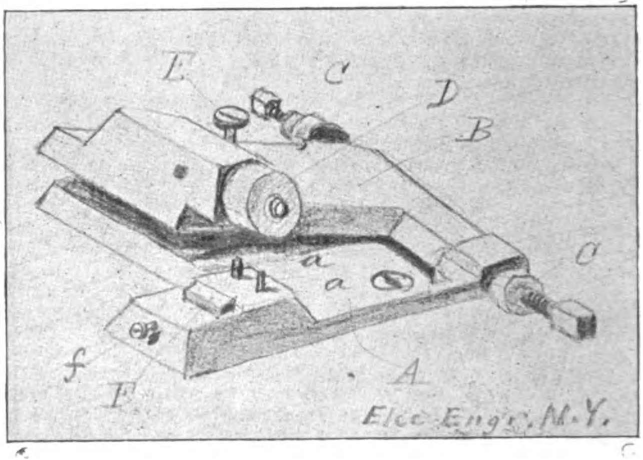
The accompanying illustration is made direct from a full-sized photograph of an incandescent lamp which has figured largely in the supplementary legal proceedings in reference to the motion for an injunction against the Beacon Company of Boston asked for by the Edison Company, which is now pending before Judge Colt. This lamp was first introduced as an exhibit by the attorney of the Beacon Company at the second hearing on February 1, and is claimed in the accompanying affidavit of the Goebels, father and son (abstracts of which are printed elsewhere) to have been made by the elder Goebel prior to 1872, and on the other hand, was denounced by the attorney of the Edison Company as a manifestly fraudulent exhibit, manufactured for the purposes of the pending case, and that within the past six months. The results of its examination by the defendant's experts will be found in brief in the affidavits of Messrs. Pope and Vandergrift, in which, as in other affidavits, it is referred to as the "Goebel lamp, No. 4." The decision in the pending proceeding, if not the ultimate fate of the Edison patent, cannot but turn largely upon the genuineness of this exhibit, or more properly upon the credibility of the witnesses by whose testimony its genuineness is sought to be established. Of the nature of this evidence, and of the credence which ought to be given to it, the abstracts of the more important affidavits pro and con, given elsewhere, will perhaps assist the reader in deciding for himself.

The lamp in question has a thin carbonized filament of bamboo of horseshoe shape, and has small flat platinum leading-in wires, sealed by fusion into an exhausted glass globe, and the whole structure in fact must be admitted to be, to all intents and purposes, identical with the commercial incandescent lamp of the present day.

Portrait of Goebel from an Old Daguerreotype.

In the accompanying engraving we show also Goebel's little bamboo filament planer. A represents the iron base; B the hinged clamping jaw; C and D, respectively, the set screw, and roller pivoted to the clamping jaw; E, the set screw for adjusting the distance of the roller D from the bed A when B is held down; F the vertical blade of the plane, beveled like a chisel; *f*, a set screw for holding F in position; *a a*, guide pins for holding the filament while being planed. The set screw E adjusts the roller D for any thickness of carbon.

We present also a portrait of Goebel made directly from an old photograph taken at the time when his story shows him to have been interested in early work on incandescent lamps, and to have made the lamps upon which the present defence is based.



Goebel's Filament Planer.

LITERATURE.

Dynamometers and Measurement of Power. By John J. Flather, Ph. B., M. M. E. *New York*, John Wiley & Sons, 1892. 215 pp. 5 by 7½. Price $2.00.

In this age of innumerable applications of power a work treating of the methods of measuring it, must be of value to all engineers. The electrical engineer, especially, is frequently called upon to estimate the quantity of power required in the operation of the endless variety of machinery which the electric motor is now called upon to drive, and he will find in the work before us a most concise and accurate guide.

The author describes all the more general forms of dynamometers including friction brakes, absorption and transmission dynamometers, and devotes attention to the power required to drive lathes and other machinery. The chapter on the measurement of water power will also prove useful to many. The book is well illustrated throughout, and the subject treated from a thoroughly practical stand-point.

Hilfsbuch fuer die Elektrotechnik. 3d. Edition. By C. Grawinkel and K. Strecker. *Berlin*, Julius Springer, 1893. 642 pp. 5 by 8. Price $4.80.

This excellent work of reference has been thoroughly revised and brought down to date. Among the new material in this edition we notice a chapter on "Magnetic Measurement," the "Polyphase System of Distribution," and the "Employment of Induction Coils and Condensers in Alternate Current Circuits." The parts devoted to systems of distribution and dynamos are especially worthy of mention, and the details of the construction of German machines, both continuous and alternating, will be of special value to the designer of dynamo machines.

LEGAL NOTES.

INCANDESCENT LAMP LITIGATION.

THE GOEBEL DEFENCE.—EDISON ELECTRIC LIGHT COMPANY (GENERAL ELECTRIC COMPANY) *vs.* BEACON VACUUM PUMP AND ELECTRICAL COMPANY IN U. S. CIRCUIT COURT, BOSTON, FEB. 1 AND 2, 1893.

The hearing in the case of the Edison Electric Light Co. vs. the Beacon Vacuum Pump and Electrical Co. was continued on Wednesday, February 1st, in Boston, before Judge Colt.

Mr. Wm. C. Witter, for the defendants, filed a printed brief, and asked leave to introduce certain exhibits and affidavits, in the nature of new evidence which could not be presented at the former hearing by reason of the short time allowed for preparation. The exhibits consisted of an incandescent lamp made by Goebel prior to 1872, having a horseshoe filament of carbonized bamboo, in an all glass globe and having platinum leading-in wires; also three old machines made by Goebel for shaping carbons, one of which has been used until quite recently in the Perkins lamp factory. Among the affidavits were several as to Goebel's good character; an expert affidavit from Mr. Pope explaning why this lamp was not permitted to be put in at the first hearing, and also stating that the exhibit lamp still held its vacuum, and a large number of affidavits confirmatory of those heretofore presented, and giving additional testimony to the public use of these lamps by Goebel. Mr. Witter said that the utmost possible diligence had been used in getting this material together, but that it had not been possible to do it in time for the former hearing, and therefore they had put in what they had.

Mr. Fred. P. Fish, for the complainants, urged that the court should either grant or refuse the injunction asked for, upon the affidavits and exhibits heretofore presented. He asserted emphatically that the defence which had been set up was absolutely fraudulent; a more bare-faced fraud even, than the Drawbaugh defence in the telephone litigation. The complainants had a large number of affidavits which would substantiate what he had said. The exhibit now presented was a lamp which a mere inspection was sufficient to show had been made within the past six months for the purposes of this case. He had understood that the case had been closed, and he objected to the admission of any more exhibits and affidavits of the same character.

The Court said that he was disposed to admit the papers and exhibits now offered by the defendant, and to consider them as if they had been part of the evidence originally offered, and to take such action as the record thus before him would justify. Unless complainants counsel entered a formal protest, this course would be pursued. The Court recognized that it was its duty to act speedily in the matter.

In reply to questions by counsel on both sides, the court observed, that after accepting the affidavits and exhibits now offered, and such additional matter as either side might offer during the day, if it were found that the new matter thus presented was controlling as to the decision, then it would be the duty of the court to hear the complainant in reply. The court realized the brief time within which the defendants had been required to prepare their case, but would consider the case closed to-day. If on examination of the record, the case was found to turn on the new matter, the court would hear arguments, and would allow both sides a reasonable time in which to file affidavits in reply and in rebuttal.

Mr. Fish said that he regretted his honor's decision, but should file a number of affidavits in reply to those heretofore presented by defendants.

The Court, on Thursday morning, took the papers and exhibits and reserved decision.

Following are abstracts of the principal additional affidavits filed by defendant.

Henry Goebel (second affidavit) says that before he removed from Monroe street in 1872 had settled upon bamboo as the best material for carbons and always used it thereafter; had then made four instruments for dressing thin threads of bamboo; found one of these at Jan. 26, 1893, and gave it to defendant's counsel (a drawing of this is given elsewhere); sold three of these instruments to C. G. Perkins about 1886; two of these now handed deponent by Mr. Perkins, are the same; one of these was made in the early sixties; by this could make strips thinner and more even than is possible by hand; pulled the strips through the instrument with pincers; had gas in his house before 1872, and had glass blowing machine and had become quite expert in the art; made hundreds of barometers and thermometers, as well as Geissler tubes, and the like. Knew that platinum was best material for leading-in wires, and almost always used it; lamp marked No. 4 (illustrated in another column) has been in deponent's possession since before 1872; has burned it a great many times; it gave a good light; made in Monroe street and afterwards a good many lamps like No. 4 except the glass work was not so well finished. Deponent told Mr. Pope he was mistaken in supposing this lamp could not have been exhausted by the Torricellian process because no traces of mercury appeared upon the interior wires; always used distilled mercury in a very dry atmosphere, which will not adhere to copper. Used a mercury-pump with stop-cocks before 1872, but did not get any better results than by the Torrecellian process. Deponent's lamps were fit for commercial use, but commerce was not ready for the lamps, because there was then no available source of cheap electricity. One of deponents earliest efforts to make a lamp was by using platinum wire as an incandescent conductor; it was two or three inches long and very fine; used it with a vacuum and copper wires sealed in the glass; it gave a good light for a few minutes and then melted and broke the glass; then tried carbon which deponent knew from experience with arc-lamps would not melt. More interest in deponent's work was shown by neighbors and friends while he lived in Monroe street than afterwards when he lived in Grand street; electrical apparatus had become less of a novelty. Deponent has received no valuable consideration for anything he has done for the defendants in this case and does not expect nor desire any; has given his evidence with reluctance and only after urging; has no interest in the result of the suit has no enmity towards Mr. Edison nor desire to injure him in any way; does not know any person connected with the defendant company. When deponent lived in Grand street made a glass fountain and exhibited it for a long time in the show window; it was a difficult piece of glass work, and numbers of glass-blowers used to stop and inquire about it; lighted up his shop in 1882 with a dynamo machine and lamps which had been on hand for a number of years; a partially correct notice of this exhibition appeared in the New York *World* of May 1, 1882. (This notice was reprinted in The Electrical Engineer, of last week, on p. 121.)

Henry Goebel, Jr., makes affidavit that the lamps with iron and copper leading-in wires were among the very earliest his father made; some of these were successful; the great majority of lamps made before 1872 had platinum wires; lamp marked "Goebel No. 4" is an original lamp and has been in their possession since before 1872; it has been kept as a sort of specimen because the glass-work was so good; have both been ready to identify it at any time if called upon to do so; but understood the lamp was under examination by the experts; could identify this lamp by its excellent workmanship and peculiar shape and appearance, even if it had been in the possession of others.

James A. Vandergrift, has examined lamp No. 4; there is a fair vacuum in it and thinks lamp would burn from 100 to 200 hours, which was a good length of life for a commercial lamp in 1880; the filament is, of course, bamboo carbonized, has been burned and is slightly oxydized upon its surface; the circuit is broken but the break does not appear to be in the carbon; sees no reason why the lamp might not have been made in 1872 or earlier.

Franklin L. Pope stated that he at first entertained doubts as to the date of lamp No. 4, because he thought if the lamp had been filled with mercury and exhausted in the manner claimed to have been practiced by Goebel, some traces of that metal would have been visible on the copper wires. Goebel had asserted that if distilled mercury were used, this effect would not take place; tested the matter experimentally on January 26 and found Goebel's assertion to be true. Remembers Geissler tubes were sold by Ritchie in Boston at least as early as 1868; some of these had platinum wires sealed into the side of the exhausted glass tube like those in Goebel's lamp No. 4; estimates No. 4 with unbroken carbon and proper current would give a light of 10 candle-power; such current was obtained in 1872 by the means said to have been used by Goebel; no apparent reason why the lamp No. 4 might not have been made prior to 1872; Goebel lamp No. 4 embodies the second claim of Edison patent in suit; has all the elements, combined and operating as therein set forth.

Prof. Charles R. Cross has examined Goebel's hair pin lamp No. 4; it embodies the invention set forth in the second claim of the Edison patent; has read affidavit of Goebel; there is nothing in appearance of lamp inconsistent with the assumption that they were manufactured as described by him, either by the use of the Torricellian vacuum or by the mercury pump; the Torricellian process would give a sufficient vacuum for a practical incandescent lamp; moreover the mercury pump was well-known in the art at the time the Goebel lamps are stated to have been made; it was pointed out by Faraday half a century ago that platinum is the best material for purpose of sealing a conducting wire into glass; it would have required no invention to substitute platinum for iron leading-in wires at the earliest date mentioned by Mr. Goebel; believes it would be practicable to make an incandescent lamp with iron leading-in wires which should have a life of a considerable number of hours; can discover nothing in the construction of any of the Goebel lamps which would make it improbable that they were constructed at the dates assigned by Goebel. In at least two important particulars the Goebel lamps are superior to the lamp specifically described in the patent in suit; carbonized bamboo is far superior to the tar putty and other filaments specifically set forth in the patent; and the carbonization of the filament while attached to the wires as contemplated in the patent, increases the liability of the occurrence of a bad joint; in the

Goebel lamp the attachment has been made subsequently to the carbonization.

EDWARD E. CARY disposes that he is superintendent of the defendant company; is thoroughly skilled in the manufacture of electric incandescent lamps; has considered the statement made by Professor Thomson and two others in this case that lamps with iron or copper leading-in wires are incapable of practical use. Deponent has known for several years that it is possible to make practical and operative incandescent lamps with iron wires sealed into the glass, but that much greater care is necessary to be exercised in sealing the lamps, and the percentage of unsuccessful sealing is much greater than with platinum. Deponent presents two lamps made within the past two days with iron leading-in wires, one being a glass tube with "meat saw" carbon, and the other a pear-shaped chamber with a "hairpin" carbon. The tube lamp has the pinched seal of the Goebel exhibit lamps No. 1, 2 and 3, the other has the ordinary commercial sealing. The first lamp has been burned eleven hours in the aggregate at full candle-power, at four different times, the lamp becoming cold during the intervals; the seal remains perfect, as deponent has found by testing the lamp for vacuum; the length of life will now be determined by the filament alone; the second lamp has been burned in the same way an aggregate of thirteen hours; it gave 16 c. p., and was cooled five times during the test; this lamp also tests for vacuum and shows no leakage; has used them as long as there was time to do so after making them.

CHARLES G. PERKINS deposes that he became acquainted with Goebel in 1880; was then engaged in making incandescent lamps, and was on the look-out for any information or assistance that would be of value; one of his employees told him he had seen incandescent lamps in Goebel's place in Grand street; went and introduced himself to him (Goebel) and asked to see the lamps he had made; this was about September, 1880; Goebel then showed deponent three or four lamps, some in shape of a tube and others with pear-shaped globes; they had very small carbon burners, and some of them had platinum leading-in wires; one had a straight carbon and the others looped carbons like those made to-day: have examined photograph of lamp No. 3, the lamp with straight carbon deponent saw at Goebel's shop in 1880 was just like it; Goebel said he had made such lamps for years and years; deponents thinks he said 20 years; deponent was astonished at the amount of his knowledge of the subject. Deponent told Goebel he had trouble with the lamps cracking; he replied that if the carbon were made small and of high resistance the leading-in wires could be made small and the liability to crack reduced. Goebel said that platinum was the best metal for leading-in wires; he gave deponent some bamboo to make carbons of and deponent made some of small cross-section as Goebel had told him to do and was very much pleased with the result; Goebel showed deponent a glass mercury pump for exhausting lamps, and told deponent how to carbonize filaments; deponent made six lamps which were tested at 120 Broadway with good results; deponent called upon Goebel frequently in 1880 and 1881; remembers seeing planers that he used in shaping his filaments; bought three of these planers from him about 1886 and still has one of them; saw Goebel blow glass at different times; he was a skilful glass-worker.

DAVID A. HALL, deposes that he resides in Newark, N. J., and prior to 1872 was a manufacturer of jewelry; became acquainted with Goebel by selling him goods; sold him goods until 1886; he was a very ingenious man, very fond of explaining his inventions to every one interested in them; very soon after deponent first became acquainted with him, saw some incandescent lamps he said he had made; they consisted of a glass tube several inches long with wires running through the glass; inside the glass the wires supported a part that lighted up; have examined the four exhibit lamps; the ones he saw at Goebel's were just like them; some had straight burners and some had hairpin shaped burners; deponent saw lamps like the exhibits prior to May 1872; deponent is positive of this date because Goebel gave him a lamp like Goebel hairpin lamp No. 4, as a keepsake; took this lamp home and showed it to his father who then lived next door: remembers his wondering what it was; deponent's father died in May 1873; deponent kept this lamp for many years; may very likely have it yet; have often seen his store in Grand street lit up with his incandescent lamps; they gave a very good light, as good as a gas jet; Mr Goebel is a man of the highest reputation for honesty and veracity, would place the utmost confidence in any statement he might make; have seen him cutting bamboo into strips; he used tools for the purpose; the wires which ran through the lamps were platinum; he gave deponent a reason at that time for using platinum; don't remember the reason he gave, except that platinum and glass were affected alike by the heat; remember Goebel using the ordinary jeweller's draw-plate to make his carbons; these draw-plates had holes of different sizes.

Affidavits were submitted from a considerable number of citizens to the good character, veracity and integrity of Mr. Goebel. Among these are Theron S. Copeland, police captain; William Newman and Edward J. Hogan, practicing physicians, and Henry Grinnell, a large dealer in jewelry, and others.

AUGUST F. HEGER, deposes that he is a glass-blower; commenced work for the American Electric Light Company early in May, 1881, worked at glass-blowing, sealing lamps and the like; the company had trouble in getting good carbons. Because of this trouble the company hired Goebel to make carbons for a considerable time at his store in Grand street; worked frequently at Goebel's place in Grand street sealing into lamps the carbons which Goebel had made; he was very skilful in making carbons; he did glass-blowing very well; Goebel had a mercury pump; he showed deponent how to make these pumps and deponent made several of them afterwards, which were used for exhausting lamps; Goebel on one occasion showed me some old lamps that he kept in the safe; the lamps were like the one in the photograph now shown. (Mr. Witter filed 31 in all of these additional affidavits.)

THE following are abstracts of affidavits presented by Mr. Fish on behalf of complainant:

WILLIAM C. DREYER says that in the spring of 1882, he undertook to form a company to purchase Goebel's invention; saw him repeatedly at that time; about April, 1882, he procured an option from Goebel for $500 to acquire all his inventions in electric lighting; he was to have a large compensation if undertaking was successful; the only inventions he had applied for patents for were the mercury pump and a spiral carbon-holder for incandescent lamps; he said he had made small incandescent lamps, which he described as "fiddle-bow" lamps several years before; spoke to him repeatedly of the importance of his finding one of those lamps; it was a great disappointment that he did not do it; got him to extend the option another three months for $425. His failure to produce any old lamp, his general unreliability of memory and freedom and looseness of statement caused deponent to distrust him, and at the expiration of the option, the whole matter was dropped and deponent lost his investment of $925. If Goebel had then had any lamps made in bygone years, deponent is certain he would have produced them; it was the vital point of the whole matter. During this period, deponent, with the assistance of Dickerson and Dickerson, approached the Edison Electric Light Company to see if they would interest themselves in these Goebel inventions; the whole matter was gone over in the presence of Mr. Dickerson, Jr., and Major S. B. Eaton, of the Edison Company, and the conclusion was summed up by Mr. Dickerson, thus: "Even if Goebel did what he claims, it is nothing but an abandoned experiment;" deponent hoped that the Edison Company would be at least sufficiently impressed by Goebel's story of what he had done to get him out of the way; but they declined to negotiate, and the matter never went so far as to talk figures.

WILLIAM MCMAHON deposes that, in the early spring of 1881, he, with George Crosby and Edwin M. Fox, organized the American Electric Light Company; started a small shop in Centre street and tried unsuccessfully to make incandescent lamps. Crosby spoke several times of an old man named Goebel whom he thought would be useful in the business; went with Crosby and saw him in a watchmaker's shop in Grand street; found him entirely familiar with all the work, which had been done up to that time in electric lighting; he spoke highly of Edison and seemed to regard him as a great inventor; he spoke English well enough to be readily understood; he showed deponent an arc lamp with a glass cover over it about nine inches high; asked him if he had ever made an incandescent lamp and he said he had not; he said he thought he could make carbons for incandescent lamps; did not say that he ever had done so; saw a vacuum pump, which appeared to be a swinging pump attached to the wall; it was not like Edison's pump; don't remember that anything was said about the pump; saw no battery or incandescent lamps about the place. Deponent told Goebel that he could make him a very rich man, if he could show an incandescent lamp made prior to Edison's. Goebel replied "Well, we might make one that would look old, eh, George," which raised a general laugh; he afterwards asked deponent to give his own work, and this was done. Deponent heard last year, for the first time, that Goebel claimed to have done anything in incandescent lighting, when questioned on the subject in the interest of infringers of the Edison patent; told them emphatically that Goebel had never done anything in incandescent lighting; deponent then believed that Goebel was being used as a tool, knowing his pretensions to have invented the incandescent lamp were fraudulent. Goebel was never employed by the American Company to deponent's knowledge; Crosby may have employed him. In 1881 there was intense excitement about the electric light; everybody recognized that Edison had made the invention; if there had been any chance for an opposition company, unlimited capital could have been secured to develop it. There was every reason why it was then for the interest of Mr. Goebel and his son to disclose fully everything he might have done in the way of making incandescent lamps, if he had done anything. Deponent has recently been approached with a view to assuming that he remembered something tending to show that Goebel had made an incandescent lamp at an early date, but declined to do so, knowing that he had never done any such work. The first fiddle-bow lamp deponent ever saw was made in Boston, in 1882.

TIMOTHY G. MCMAHON says he accompanied Crosby and William McMahon on the visit to Goebel's shop in 1881; saw a glass water fountain in the front window; saw an arc lamp and a vacuum pump; saw some V-shaped carbons, supposed they had been brought by Crosby; Goebel made no claim to having made them; said he had never made an incandescent lamp, but had made an arc lamp, and that he would like to go into the incandescent lamp business; said he had never made any carbons; remember his saying he could make a lamp that would "look old." Deponent afterwards saw Goebel many times; he never claimed to have anticipated Edison's invention. About September, 1881, deponent, in company with a glass blower named Kuhn, spent an afternoon in Goebel's shop, and showed him how to exhaust and seal incandescent lamps, using bulbs and carbons taken from the shop of the American Company; this was the first time deponent ever saw an incandescent lamp in Goebel's place; Goebel never worked for the American Company to deponent's knowledge; his son was employed there for several months, but not to deponent's knowledge, on pumps or carbons. Crosby had known Goebel for many years. Deponent has made a sketch, representing the arc lamp, which Goebel showed him on his first visit to his place. The first fiddle-bow lamps were made in Boston and were then considered to be a way of evading Edison's claim for a horse-shoe carbon.

Otto A. Moses, mining engineer and chemist, entered the service of Mr. Edison in 1879; went to Paris in his behalf in 1882; was familiar with all his work; subsequently tried to construct an incandescent lamp, which would not infringe Mr. Edison's; heard of Goebel and called on him at his shop in Grand street in 1884: saw his glass blower's table and mercury pump; Goebel made some canes for deponent which deponent carbonized at his own laboratory. Goebel asserted confidentially to deponent that he (Goebel) was the inventor of the Edison lamp; that he had made them a great many years before; asked him to show some of his old lamps, but he had none to show; he never did show him any lamps, which he pretended had been made before the date referred to; conversed with him in German; he was extremely intelligent and keenly alive to the value of his services.

Ludwig K. Bohm is a consulting engineer and chemical expert; became an assistant of Mr. Edison in August, 1879; was superintendent of American Electric Light Company in 1881; while there invented the "stopper lamp" Knew George Crosby; he had worked in the carbonizing department at Edison's laboratory; deponent made Goebel's acquaintance at this time; went to his place; saw his mercury pump; he never once mentioned that he had made incandescent lamps earlier than Edison; accounts of Edison's work were published in the German newspapers and deponent thinks he must have been conversant with Edison's work and have recognized the great importance of an invention, which would have anticipated it. Deponent got the impression that Goebel was eager to obtain money, and that if he had had such an important invention he would certainly have presented it to the officers of the American Company. Deponent has read the affidavit of D. C. Voss; Voss was employed by deponent in the carbon department of the American Company; was very friendly with him; he never said anything about the lamps, which Goebel pretended to have made prior to Edison's invention; believes he would have done so if he had known of any such thing; deponent was a pupil of Dr. Geissler; he (Geissler) invented the mercurial pump in 1858; the vacuum tubes were invented about 1860; deponent knows of nothing on record showing that previous to this, electric currents could be introduced into glass vacuum tubes; believes that the state of the art was not sufficient to enable the production of such results as are claimed by Goebel to have been obtained in the early fifties. Had read Goebel's affidavit, describing how he exhausted his lamps; a vacuum produced in this way would not be sufficient to enable a filamentary carbon to last, because there is always air in the mercury, and air also clings to the glass walls, leaving sufficient in the lamp chamber to prevent the filamentary carbon from lasting. Mr. Goebel does not say that he boiled the mercury, which is necessary to get the air out of the mercury; the method of exhaustion described by Goebel is impracticable with filamentary carbon, because the carbons will be broken by the mercury; the "hair-pin" carbons in every instance, and a large proportion of the "meat-saw" carbons as well. Goebel's lamp shows very poor workmanship; No. 1, may never have burned or had a vacuum; No. 3, has concavities at the top where sealed off; these concavities are not proof that the vacuum in the lamp chamber was sufficiently high to make a filamentary carbon last. The exhibit lamp does not exhibit the partial decomposition upon the surface which they would be likely to, if allowed to lie for years exposed to atmospheric influences.

Albert Hetschel deposes that he is a glass blower and manufacturer of physical and chemical apparatus; was employed by the American Electric Light Company in the summer of 1881 to help Henry Goebel make incandescent lamps at his shop in Grand street; worked with him every day for four months, and became intimate with his family; he knew very little about lamp manufacturing; he tried to make filaments out of old paper; he had a crude vacuum pump; he made four little lamps from pieces of carbon, which he took from a Maxim lamp, mounted them in glass bulbs blown by deponent and hung them in his window; these were the only lamps he ever made while deponent was with him; was satisfied he did not have the capacity to make a lamp; he never said one word about having ever before done anything with incandescent lamps; never mentioned the subject in any way; was greatly surprised to learn from the newspapers last week that Goebel claimed to have invented the incandescent lamp before Edison. Goebel never said that he had ever made incandescent lamps before his employment by the American Company, nor did he claim any priority over Edison, although there was every opportunity and inducement for him to do so; deponent never heard until within the past week that Goebel claimed to have made incandescent lamps prior to Mr. Edison's invention.

A considerable number of witnesses make affidavit to having frequently been in Goebel's store in Monroe street or to having looked through his telescope on a wagon; none of them ever saw or heard of an electric lamp in connection therewith. Some remember lights on the wagon; there was nothing remarkable about them; think they were common oil lamps.

Major S. B. Eaton, in his affidavit, confirms the statements contained in the affidavit of W. C. Dreyer, but adds no matter of importance, except that in November, 1882, Henry Goebel, Jr., called and offered him, as representative of the Edison Company the inventions and good will of Goebel for $20,000; the company considered the matter and declined to purchase at any price.

John W. Howell, electrician of the Edison lamp works, deposed that lamps having leading-in wires of iron or copper will not hold a vacuum; does not believe that filamentary carbon lamps can be made in the manner described by Goebel in his affidavit; the concavities in No. 3 proved that it had a very low vacuum when it was sealed, and one entirely insufficient to preserve a filament at incandescence.

Franz Holzer, foreman of the glass department in the Edison lamp works at Harrison, N. J., confirms the statements of Mr. Howell.

Edward R. Knowles, deposes that he succeeded William Stanley, Jr., on June 5, 1882, as electrician of the American Electric Light Company; never saw Henry Goebel, but heard of him from employees of the shop. The story was circulated that he had made incandescent lamps prior to Mr. Edison; it made no particular impression on deponent's mind; one of the employees of the factory gave deponent a lamp which he said Goebel had made; it was given deponent as an old lamp. Deponent herewith produces what is left of it.

William Stanley, Jr., states that he is familiar with incandescent lamp manufacture; was connected with the American Electric Light Company, from the fall of 1880 to the summer of 1881; was superintendent and engineer; it was of great importance to the company to be able to make a lamp which would avoid the Edison patents; Henry Goebel was employed by the company; he made and mounted filaments and exhausted the lamps.

LETTERS TO THE EDITOR.

THE ST. LOUIS-CHICAGO ELECTRIC RAILWAY.

I recently saw the charge that the electrical press had not done its duty in warning the public against the Chicago and St. Louis Electric Railroad Company's project, characterizing it as a "wild-cat, through-by-lightning scheme" that was being worked on the unsophisticated public to obtain their cash for stock. The Engineer must then stand this charge, for I notice that it has taken no such radical stand.

Surely though, this cannot be the general opinion among the engineers. For who is to say, whether the scheme is practicable—someone who believes electricity will advance just so far and no farther in its application, or some *practical* engineer with broader ideas? I should like to hear the sentiments of some of this latter class upon this important enterprise.

J. Wilson Brown.

Brimfield, Mass., Jan. 19, 1893.

[Up to the present time The Electrical Engineer has not vouchsafed any opinion, one way or the other, as to the practicability of the St. Louis and Chicago electric railway scheme, projected by Dr. Wellington Adams. The reason for this will be clear when we point out that up to the present writing we have not been placed in possession of any of the working details of the methods to be adopted. It would, indeed, ill become anyone at this period to assert the impossibility of the successful accomplishment of an electric railway scheme, in the light of the experience of the last few years; but an undertaking such as that contemplated by Dr. Adams must for its success—and by success we mean financial as well as technical—depend upon many factors. Unfortunately we have still to see a thorough analysis of the scheme in all its bearings, upon which alone we would be prepared to base an opinion. The estimates of financial results of operation set forth in the advertisements of the company, strike us as very visionary, but whether their rosy nature is due to enthusiasm or to something worse, we cannot tell.—Eds. E. E.]

PAPERS TO BE READ AT THE N. E. L. A. CONVENTION IN ST. LOUIS.

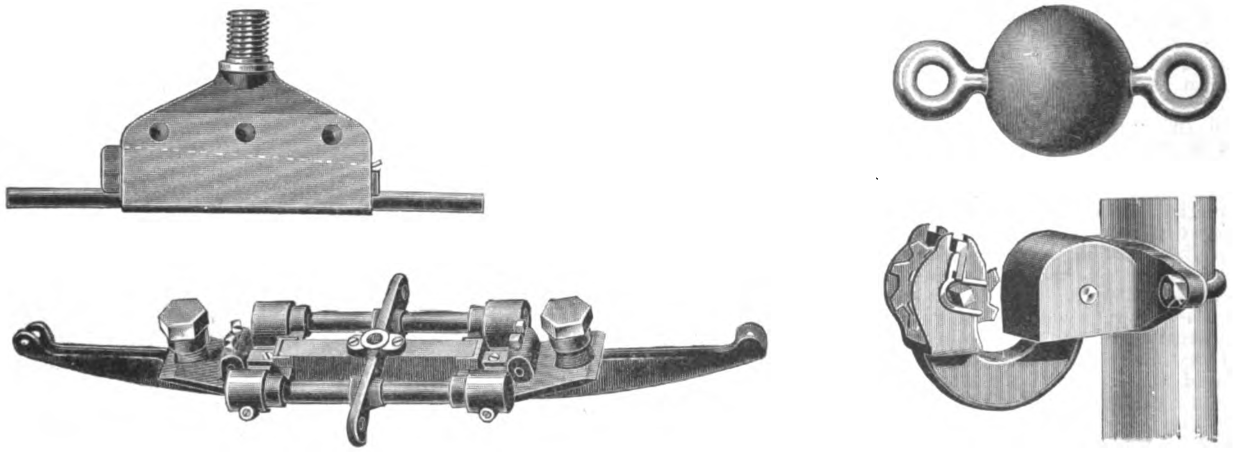
MR. GEORGE F. PORTER, secretary of the N. E. L. A. writes us, that in addition to the lecture by Mr. Tesla, in which he will give practical demonstrations of high frequency and high potential currents, the following papers will be read: "Some Experiences with the Alternating System," by Mr. Sterling; "Long Distance Transmission of Power," by Mr. C. S. Bradley; "Under What Conditions is the Use of Water-Power Economical?," by Mr. L. B. Stillwell; "Preservation of Poles and Cross Arms," by Mr. Myers; "The Incandescent Lamp," by Mr. Townley. Messrs. Stanley, Brophy, Bell, Armstrong, Browne and Adams have promised to read papers on subjects to be announced. Prof. Geo. Forbes, writes from London that in all probability he will attend the St. Louis Convention; and if possible prepare a paper.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

ELECTRIC RAILWAY APPLIANCES OF THE NEW YORK ELECTRICAL WORKS.

THE NEW YORK ELECTRICAL WORKS, of 161 Washington street, New York City, are introducing a number of interesting specialties in electric railway line material, some of which are shown in the accompanying illustrations. While the company realizes fully the fact that the best apparatus is none too good in this exacting class of work, they have endeavored to so simplify the construction as to produce articles that will be perfect, and, at the same time, not exorbitantly high in price.



FIGS.—1, 2, 3 AND 4.—ELECTRIC RAILWAY APPLIANCES OF THE NEW YORK ELECTRICAL WORKS.

Believing that the application of hot solder is detrimental to tempered copper wire they have made all their fittings with mechanical clamps so securely applied that the wire will give way outside the fitting before the clamp will yield.

Fig. 1 shows the mechanical trolley wire clip. As will be seen, a sheet of copper is bent around the wire and rivetted to the main body piece of the clip, a wedge being firmly driven in between the latter and the wire. This wedge has a slit at the small end which, by the blow of a cold chisel, is opened and the wedge securely locked. In the newer form of clip, hook shaped lugs are cast on the body piece, and the action of the wedge also holds the copper strap in place without the use of rivets.

Fig. 2 shows a strain insulator using the Medbery insulation. This material is manufactured by the Fiberite Company for the New York Electrical Works and is applied hydraulically under a pressure of 150 tons. In a recent tension test, one of the eye bolts was actually torn apart before the insulating material cracked appreciably. The Medbery compound is waterproof, and not brittle, and hence is especially adapted to line work where it is necessarily subjected to more or less rough usage. It is the invention of Mr. H. J. Medbery, of Mechanicsville, N. Y., who has long been interested in such work, and has made a number of highly ingenious improvements.

The circuit breaker, Fig. 3, is secured to the wire by rivetting together the ends lugs and forcing a clamping wedge into a groove, as in the other fittings made by this company. The construction is such that the entire destruction of the insulation will not affect the suspension of the trolley wire.

Fig. 4 shows a novel form of pole ratchet. An insulated sleeve and bushing separates the two parts and is kept well up inside of the hood. The ratchet device, as may be seen, is very simple and effective, and perfectly accessible to the lineman.

The New York Electrical Works are constantly experimenting with a view to improving their apparatus, and have produced some very creditable work.

THE "DIAMOND" TRANSFORMER WIRING RULE.

THE neat little catalogue just issued by Messrs. Taylor, Goodhue & Ames, of Chicago, on their "Diamond Transformers," besides giving an excellent description of the apparatus, contains in addition most useful information for station managers. Thus we may quote the following on the subject of "Wiring:"

Badly designed wiring from the transformer to the lamps often leads to variations of the candle power in the lamps that, almost without exception, is laid to poor regulation in the transformer. The voltage of the secondary circuits cannot increase to compensate for the loss in leads at heavy loads, and since the loss varies on any set of leads with the square of the load in amperes, it follows that the secondary wiring should be so designed that the loss will never exceed a very small predetermined amount.

When the transformers are placed so far from the lamps as to make the cost of leads excessive for the 50 volt distribution, the "3-point" type of transformer is almost a necessity. By simply making one connection, the voltage of secondary circuits is changed to 100 volts, reducing the size of wire in sectional area to supply a given number of lamps to one quarter of what would have been necessary on the 50 volt plan with a given per cent. of loss. In large buildings this is an extremely important item.

For the benefit of those desiring a simple formula for calculating leads for multiple distribution, we print the following:

$$\text{C. M.} = \frac{21.21 \times C \times D}{E}.$$

In this formula,

C. M. = Area of wire in circular mils.
21.21 = Constant for 2 mil feet of copper wire.
C = Current in amperes.
D = Distance in feet to lamps.
E = Volts loss in conductor.

THE COMMERCIAL ELECTRIC COMPANY.

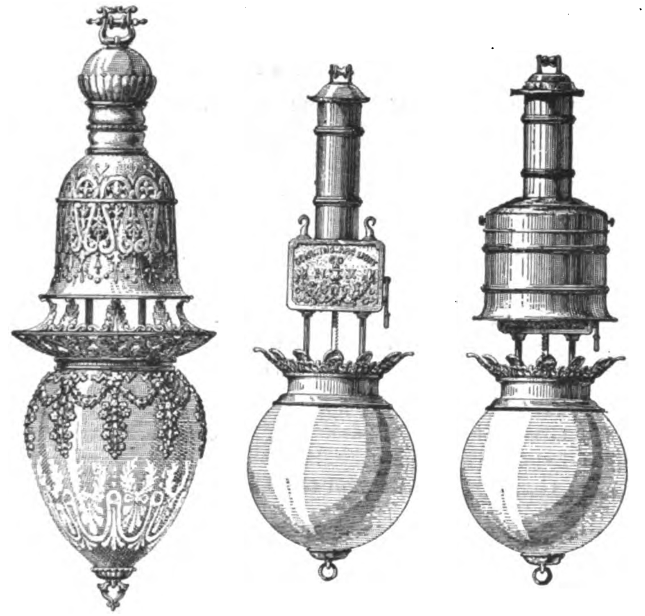
THE COMMERCIAL ELECTRIC COMPANY, of Indianapolis, has recently appointed the following agents: Chicago, Mr. Fred Wolfrum, 455 The "Rookery;" St. Louis, E. G. Bruckman, of the Electrical Engineering Company, Equitable Building; Louisville, Southern Engineering Company, 238 Fifth street; Cleveland, W. D. Graves, Electrical Manufacturing Company, 8 Case place; Toledo, Bissell & Dodge, 518 Summit street. The Commercial Company has in a short time built up what promises to be a very successful business for so young a concern. Mr. A. D. Adams, the manager and electrician of this company, has had a wide experience in this class of work and is the inventor of the apparatus the company is manufacturing.

Mr. Fred L. Wolfrum, the new Chicago agent, formerly represented the Detroit Motor Company, and later the Jenney Electric Motor Company, in Chicago. Mr. Wolfrum is a young man, but his very successful work in introducing the Jenney motor and the Detroit Motor Company's apparatus in Chicago has already placed him in the front rank.

THE GENERAL INCANDESCENT ARC LIGHT CO.'S NEW ARC LAMPS.

Considering the large increase in candle-power which can be attained for a certain expenditure of energy in the arc lamp as compared with incandescent lamp, it is strange that the arc lamp on incandescent circuits is not more in use to-day than we actually find it in practice. Nevertheless this method is steadily gaining ground and we are convinced that arc lamps on constant potential circuits will, in the near future, occupy a position quite as prominent as, if not more so, than the incandescent lamp itself. In order, however, that it may attain this desired preëminence the arc lamp must be of a character such that it will practically equal the incandescent lamp in steadiness of illumination, and on the other hand its range of illuminating power must be variable to suit the needs of each individual customer. To begin with the fiest consideration,—steadiness,—an arc lamp on a constant potential circuit must be able to take care of any variation in the voltage of the circuit from which it is operated, and to which these circuits are necessarily subject from time to time. Again, the consumer must be able to vary the candle-power of his lamp without causing the substitution of a new lamp, or the introduction of any auxiliary apparatus.

With these general objects in view The General Incandescent Arc Light Co. of this city, have just brought out a series of new lamps which possess a number of most interesting features that were well illustrated in a recent test which we had the pleasure of witnessing. The lamp itself has a most simple mechanism embodying but one magnet and three wheels with a single spring, and without a dash-pot. The upper carbon holder has a very simple universal joint which permits the carbon to be lined up perfectly true, independent of any curvature in the carbon itself.



General Incandescent Arc Light Co.'s New Arc Lamps.

One of the most serious expenses in the operation of arc lamps is the globe breakage, which is due almost entirely to the necessity of removing the globe when trimming the lamp. The present lamp is so designed that the globe is not disturbed during trimming. This is accomplished by making the lower carbon holder removable from the bottom of the lamp; the holder consists of a slotted screw which automatically grips the carbon when the holder is screwed home in the bottom of the lamp. Both the upper and lower carbon holders are arranged to take any sized carbon.

The standard lamps are run 2 in series, but one of the most marked characteristics of the new lamp, and one which will be at once appreciated by central station managers as well as by the owners of isolated plants, consists in the fact that these lamps can be run up to 6 amperes at present, three in series, on a 110 volt circuit, or six in series on a 220 volt circuit. The enormous gain effected by this method of operation will be readily apparent when we consider that in the ordinary method of running arc lamps on constant potential circuits a very large proportion of the energy is consumed in the resistance which it is necessary to include in series with them. Thus, taking the ordinary 110-volt circuit with two arc lamps in series, each operating at 42-volts, there would be 84-volts consumed in the lamps proper while no less than 26-volts would be consumed in overcoming the resistance, thus involving a loss of nearly 25 per cent. in current energy. With the lamps we are describing, and which are operated three in series, each lamp takes 35-volts, making a total of 105-volts consumed in the lamps and only 5-volts consumed in overcoming the resistances in series, and hence involving a loss of only five per cent., that is to say one-fifth the amount lost in the previous case.

While the aggregate illuminating candle power of each series is not only considerably greater than that of the two lamps in series, it is obvious that the three lamps permit of a much better distribution of the light than could possibly be obtained with two, so that in this respect also the gain in illumination is considerable.

We have already referred to the necessity of arc lamps on incandescent circuits being able to operate at varying voltages without adjustment. Some experiments we have witnessed on this point give remarkable proof of the excellent design of the General Incendescent Arc Light Company's new lamps. Thus three lamps in series operating at a normal potential of 110 volts had their potential increased until it reached 120 volts. Not the slightest flicker or tremor in the arc could be noticed, the only effect being the increase of the illuminating power of the lamp. Starting at 120 the potential was then decreased to 100 volts, that is, 10 volts below normal, and still without any effect on the lamps except a natural decrease in candle power. When we consider the frequency with which the voltage on constant potential circuits is apt to vary, this quality of the lamp will be throughly appreciated by both central station managers and owners of isolated plants.

But in addition to this excellent quality of the lamp it frequently happens that the customer desires to increase the candle power of his lamp, or to decrease it, which may be readily accomplished by increasing the current in the lamp. To attain this end each lamp is provided with a resistance which is placed on the top of the lamp and surrounding the upper carbon tube. We witnessed an experiment demonstrating the fact that the lamp can run with a current of from 8 to 20 amperes without a single re-adjustment of the lamp mechanism proper, all that was necessary being the shifting of the contact on an external resistance connected in series with the lamp. On the rack-rod lamp the resistance is attached to the lamp itself and, we may add, is insulated from the body of the lamp by porcelain insulators, thus avoiding the leakage which occurs when asbestos is employed and which is apt to absorb moisture. An external resistance has also been designed which may be placed at any convenient point in the circuit, and which can be readily gotten at without touching the lamp. For this purpose a frame has been designed upon which the German silver wire is wound on porcelain saddles, thus making a perfectly fire and moisture proof construction.

Various styles of these lamps from the ordinary plain type to the most ornate, have been designed by the company, a few of which are illustrated in the accompanying engravings. The lamp designed to burn twelve hours is 42 inches in length and weighs only 18 pounds, operating three in series at six amperes and giving between 700 and 800 c. p. each. The 8 and 10 ampere lamps operating 2 series give respectively about 1000 and 1300 c. p.

For low ceilings and with a view to supplying a demand which is bound to occur at no distant day the company has designed, and will shortly introduce, a small ribbon lamp, which is called the Bijou lamp and which is admirably adapted for interior illumination for the smallest apartments, and the illumination of which can be varied from 150 c. p. up, like that of the larger lamps. The steadiness of this smaller lamp, which we have seen in operation is equal to that of the incandescent lamp, so that the old objection as to the unsteadiness of the arc light and hence its unfitness of the illumination of living rooms is now a thing of the past; and we believe the day is not far distant when the small arc lamp will be seen in the salon as well as in the public hall.

The General Incandescent Arc Light Company, of which Mr. S. Bergmann is president, has its general office at the corner of Duane and Elm streets, New York City, with show-rooms at No. 275 Fifth avenue. The works of the Company occupy a large building which it owns on the corner of Thirty-third street and First avenue, where the smallest details of the lamp are manufactured on the spot, the equipment of the factory being admirable in every respect.

NEW SUBWAYS FOR ELECTRIC WIRES IN NEW YORK.

The Board of Electrical Control has adopted a resolution directing the engineer to report a district below Fifty-ninth street, east or west, in which the poles can be taken down and subways built. The Board granted permits to the Metropolitan Telephone Company, Mt. Morris, Edison, Manhattan, and Harlem Electric Lighting Companies, and the Empire Subway Company to build subways in about one hundred and fifty streets below Eightieth street.

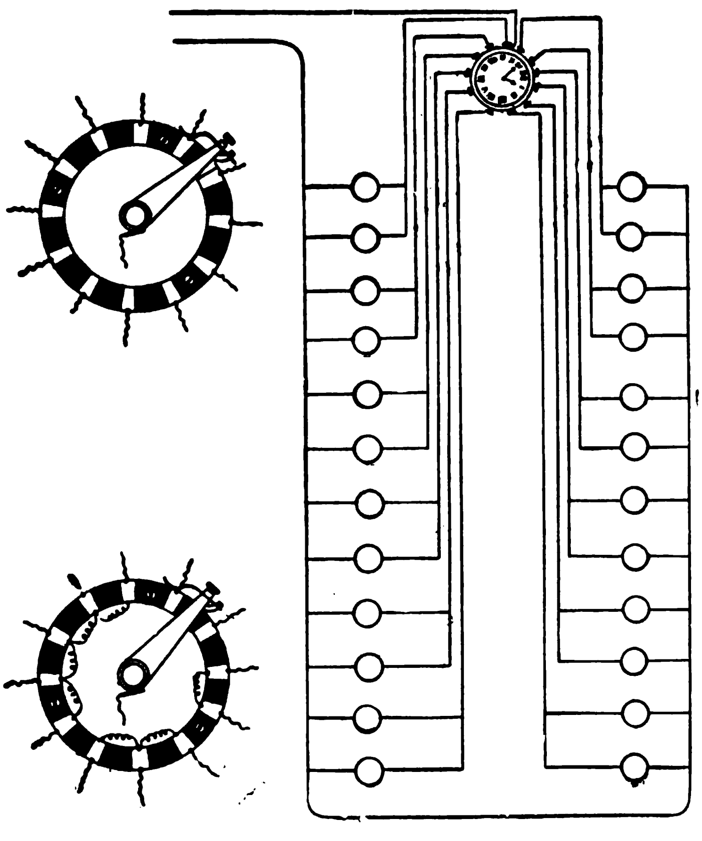
It was decided to permit no subways to be built in newly paved streets, and the companies were informed that if they desired subways in the streets which have been designated to be repaved they must be active.

ELECTRICAL DISPLAY ADVERTISING.

A UNIQUE invention in connecton with display electrical advertising in street cars operated by electricity has been made by Mr. H. T. Richards, advertising manager of the *Electrical Review*, New York. Mounted along the ordinary advertising space, on both sides of the car, is placed in neat frames, glass of any shade ground on one side, cut in the usual size of the street car advertising panel, and concealed behind this glass are placed incandescent lamps and reflectors.

The advertising copy used with this invention is of sheet-iron, tin, cardboard or any opaque substance, that which corresponds to type, trade-marks or designs being cut out to allow the light to shine through.

The strongest feature of this invention, from the advertiser's standpoint, is the fact that only one advertisement is illuminated at a time. The light behind the one illuminated is allowed to burn steadily for from half a minute to a minute, when it dissappears without noise or warning as suddenly as it came. After a slight interval another panel comes into life and light with the same length of display; and so by the same process all the panels or advertisements are illuminated one at a time. When an advertiser requires two or more panels for his advertisement, they can of course be operated simultaneously.



RICHARDS' ELECTRICAL DISPLAY ADVERTISING DEVICE.

The electrical device which operates these advertisements is shown in the accompanying illustration.

The current used in driving the car lights the lamps, and a clock placed in the car serves the double function of telling the time and furnishing the means of periodically illuminating the panels. The circuit connections are so arranged that an automatic circuit closer, controlled by the clock, will cut into and out of action, successively, the lamps behind the several panels.

This mode of advertising is as practicable during the day as in the evening, as the advertising space is immediately surrounded by the solid walls of the car, and, the lamps being placed against the dark background, there will be no difficulty in seeing the light.

AN IMPORTANT ELECTRICAL INDUSTRY FOR DULUTH.

A POWERFUL combination of electrical companies has been organized into a new corporation which will make Duluth its headquarters for the manufacture and sale of every class of apparatus for light, power, traction, etc.

The organization of the Great Western Manufacturing Company has just been completed. Its articles of incorporation have been filed and its officers elected. The company is a consolidation of five concerns each of which was a large institution. In the consolidation are included the Great Western Electrical Supply Company of Chicago, the Chicago Insulated Wire Company of Sycamore, Ill., the Phœnix Manufacturing Company of Duluth, the Bain Electrical Manufacturing Company of Chicago. The capital stock of the consolidated companies is $1,500,000, of which sum $1,300,000 has been paid over in stock for the various plants absorbed. There has been issued also $200,000 of preferred stock for a working capital. Of this last sum $100,000 has been taken up in the East. Duluth has taken the other $100,000.

The men behind the new company are in themselves all the guarantee needed to assure its stability and good management. The officers chosen are: President, T. P. Casey, formerly vice-president and now director of the Northwestern National Bank of Minneapolis; first vice-president and managing director, R. S. Munger; second vice-president, Hon. Stephen J. Young, president of the Union National Bank, Brunswick, Me.; third vice-president and assistant treasurer, O. H. Simonds, general manager of the West Duluth Land Company; secretary and treasurer, H. A. Odell, of Chicago; general manager, E. R. Gilman, formerly president of the Northwestern Thomson-Houston Company, of St. Paul; assistant general manager, T. C. Rafferty.

Among the stockholders are such men as ex-Gov. Merriam, whose personal representative in the management is Mr. Odell, Col. C. H. Graves, Clinton Markell, Joseph Selwood, Clague & Prindle, Pantou & Watson, R. M. Newport, St. Paul, A. Harrington and many others, among them men of national reputation in the world of industry and finance.

As would be expected from such a company the plan of operation is very wide in its scope. When the business is in full operation anything can be furnished from a push-button to a fully equipped electrical street car line.

PHILADELPHIA NOTES.

MESSRS. QUEEN & CO., INCORPORATED, Philadelphia, report a steady demand for their portable photometer, which accurately measures the candle power of incandescent lamps, and can be used wherever desired. It is very important from an economical standpoint, for a central station manager to use lamps that give the greatest illumination for energy consumed and this convenient apparatus enables comparisons of different types to be quickly made. When a customer complains of poor light an impartial test will settle the dispute much more quickly than words, and there is no appeal. The makers issue descriptive circular No. 295, which gives full particulars of the device.

HARRY S. SMITH & CO. LIMITED, have been appointed agents for Philadelphia and vicinity for the Dewey Electric Heating Company's apparatus. The company are placing a 60 light plant at Cramp's Gun Factory, a 200 light plant for W. W. Bache & Company, wiring Haddon Hall and the New Casino at Atlantic City, and report a thriving business generally.

MR. G. A. WILBUR, agent for the Fort Wayne Electric Company, has contracted to place two 60 and one 80 Wood arc light machine with 200 arc lamps in the station of the Powelton Electric Company of West Philadelphia. They have also received their fourth order for a 1,000 light Slattery alternator from the same company.

MR. C. S. CLUNN, mechanical and electrical engineer, of 1,217 Filbert street, has closed a contract for an incandescent plant of 500 lights to be fed by a C. and P. Dynamo at Moore's Windsor Hotel. A 50 H. P. Valley automatic engine, boilers, feed pump, etc., are included in the plant.

WESTERN NOTES.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., will build the new machine shop for S. F. Hodge & Co., Detroit, Mich. The building will be 150 feet long and of the modern type, the central portion being 40 feet in width controlled by a traveling crane of 20 tons capacity, with a wing on each side 22 feet in width, the wings being two stories high. When completed it will be one of the best machine shops in the North-West.

WM. H. MCKINLOCK, president of the Central Electric Company, has just returned from a short trip in the east, where he has perfected arrangements for the introduction and sale of several new specialties, which, when put on the market, are expected to create considerable attention and interest in the electrical trade.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XV. FEBRUARY 15, 1893. No. 250.

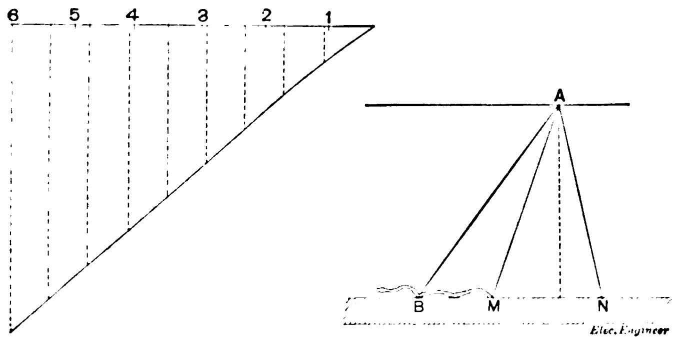
THE THEORY OF SUBMARINE CABLE LAYING.—I.

BY

Geo L Littlehales.

THE form of the curve assumed by a submarine cable during the process of laying and the different tensions to which it is subjected under the various conditions which arise were first investigated by Sir William Thomson who published his results in October, 1857. In the following February, Messrs. Longridge and Brooks laid before the Institute of Civil Engineers, at London, a complete mathematical analysis of the conditions which obtain in cable laying, basing their reasoning upon the proposition that the resistance experienced by a cylinder in moving through water in the direction of its axis varies as the square of the velocity. The dictates of this theory were followed in the practical laying of cables up to 1874, when Dr. Werner Siemens presented to the Berlin Academy of Sciences a new theory based upon the law of simple proportionality between the resistance and the velocity in the case of a cylinder of small diameter relative to its length moving in the direction of its axis through water, to which he had been led by his own experiments and by the experiments of Poiseuille concerning the motion of liquids in capillary tubes, and also by the statements of Newton and Coulomb.

Other experiments made in 1856 with the tubes of the pneumatic service in Berlin, had proved to Dr. Siemens that with tubes of large section and with considerable velocities, the law is more complex and may be represented by an expression of the form $av + bv^2$, in which v is the velocity of the cylinder and a and b are constants of which the second is small and can be neglected for values of v which do not surpass a certain limit.



FIGS. 1 AND 2.

The theory which is here given is that which has governed practical cable laying for the last seventeen years. In it the law of simple proportionality between the resistance opposed to the motion of a cylinder in the direction of its axis and its velocity is admitted, and the views of Dr. Siemens are, in the main, presented. All authors agree that when a cable is moved through water in a direction perpendicular to its length the resistance varies as the square of the velocity with which the cable is moved.

When a cable is paid out without tension from a ship moving with a uniform velocity, it will pass in nearly a straight line from the surface to the bottom of the ocean. This will appear by supposing that a ship, moving at a uniform speed, lets drop at equal intervals, balls of the same density and diameter as the cable, Fig. 1.

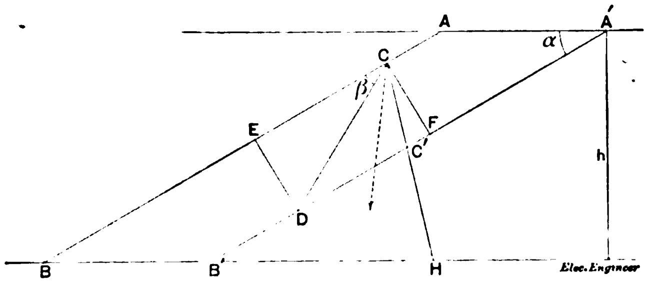


FIG. 3.

On account of the resistance which the water opposes to the descent of these balls, their motion, in a vertical direction, will soon become uniform, for it has been shown that a ball of the same density and diameter as the first Atlantic cable would acquire, in $\frac{6}{10}$ of a second, a velocity of 39.32 inches per second which differs from its final velocity by only $\frac{1}{3000}$. Therefore, the vertical space passed over by any ball up to a given instant is nearly proportional to the time elapsed since the ball was dropped and consequently to the distance passed over by the ship since the ball was dropped, and the centers of all the balls will be found at any moment to lie on a nearly straight line drawn obliquely between the surface and the bottom, whose inclination depends solely on the velocity of the ship.

If the centres of these balls be supposed to be joined by an infinitely thin thread to which the water can oppose no resistance, a sort of cable will be formed which can be paid out without tension and whose slack will depend only on its inclination and consequently on the velocity of the ship.

The part of a submarine cable suspended in the water during the laying, being very flexible on account of its great length, can be considered as being made up of independent elements. But each of these elements rests upon a kind of inclined plane formed by the layer of water in contact with it and is forced in a direction opposite to the course of the ship instead of falling vertically like the balls referred to. Thus the element A, Fig. 2, instead of coming to a point N, such that $BN = BA$, will arrive at an intermediate point M, and the whole length of the cable paid out will occupy a sinuous curve between the points B and M. Therefore the expression $\frac{AB - BM}{BM}$ will represent the percentage of loss or the slack of the cable.

In Fig. 3, let A B represent the initial position of the cable; A A′, the space passed over by the ship in a unit of time; and A′ B′, the new position of the cable at the end of a unit of time. Any point C of A B, instead of coming to the point C′ determined by the intersection of A′ B′ with a line CH, such that BH = BC, will follow the line CD and come to D. If the displacement CD be decomposed into two parts, CE and CF, lying respectively parallel and perpendicular to the direction of the cable, C′D will represent the excess of cable paid out in a unit of time and consequently $\frac{C'D}{A'A}$, the slack.

Let α represent the angle formed by the direction of the part of the cable undergoing submergence with the horizon ;
β, the angle formed by this direction with the direction followed by each element of cable during its descent into the water ;
f, the force with which the brake retains the cable on board the ship ;
h, the depth of the ocean at the point where the cable touches bottom ;
l, the length of the cable suspended in a straight line in the water ;
m, the slack ;
p, the weight in water of a unit of length of the cable ;
q, the cöefficient of longitudinal friction of the water on the cable, or the resistance which the water opposes to the motion, in the direction of its axis, of a cylinder or cable of unit length moving with a unit of velocity ;
r, the coefficient of transverse friction including the resistance which is overcome in displacing the water when the motion takes place in a direction perpendicular to the axis of the cable, or the resistance which the water opposes to the motion, in a direction perpendicular to its axis, of a cylinder or cable of unit length moving with a unit velocity ;
t, the constant velocity with which the cable falls in the water with its axis vertical ;
u, the velocity of its fall with its axis horizontal ; and
v, the constant velocity of the ship.

The quantities t, u, and p have special values for each cable, which are determined by experiment before laying.

They are connected with the coefficients q and r by the following relations :

$$p = q\,t \qquad (1)$$

$$p = r\,u^2 \qquad (2).$$

The weight $p\,l$ of the cable may be decomposed into two forces, one $p\,l \sin\alpha$ directed along its axis in the opposite direction to that in which the force of longitudinal friction and the holding of the brake is exerted, and the other $p\,l \cos\alpha$ perpendicular to the direction of the cable and opposed to the force of transverse friction and the displacement of the water. As the motion of the cable is uniform, all the forces acting upon it must be in equilibrium. Therefore

$$p\,l \sin\alpha - q \times \text{CE} \times l - f = 0 \qquad (3)$$

$$p\,l \cos\alpha - r \times \text{CF}^2 \times l = 0 \qquad (4).$$

In the second of these equations, replacing CF by its value $v \sin\alpha$ and p by its equivalent $r\,u^2$ as derived from equation (2), we have

$$\cos^2\alpha + \frac{u^2}{v^2}\cos\alpha - 1 = 0 \qquad (5),$$

$$\text{from which } \cos\alpha = -\frac{u^2}{2\,v^2} + \sqrt{1 + \frac{u^4}{4\,v^4}} \qquad (6).$$

The minus sign is neglected before the radical because the angle α is always smaller than 90° and consequently its cosine is always positive.

Solving equation (5) for $\frac{u}{v}$, we have

$$\frac{u}{v} = \frac{\sin\alpha}{\sqrt{\cos\alpha}} = \tan\alpha\,\sqrt{\cos\alpha} \qquad (7).$$

Since the triangle BCH is isosceles, BCH $= 90° - \frac{\alpha}{2}$; and since BCF $= 90°$, C′CF $= \frac{\alpha}{2}$. Substituting in (3) the value CE = FC′ + C′D $= v \sin\alpha \tan\frac{\alpha}{2} + m\,v$ and the value $l = \frac{h}{\sin\alpha}$, we have

$$f = p\,h - \frac{v}{t}\,p\,h\left(\tan\frac{\alpha}{2} + \frac{m}{\sin\alpha}\right) \qquad (8).$$

In the above equation when $v = 0$, which is the case which arises when the ship is for any reason stopped during the immersion of the cable, f, or the force with which the brake must restrain the cable to prevent its paying out, has its maximum value, ph, which is the weight in sea water of a length of the cable sufficient to hang vertically from the surface to the bottom of the ocean.

This value ph is also a measure of the restraining force which the brake must exert when the ship moves with sufficient velocity to lay the cable without slack.

$$\text{Putting } Q = \frac{v}{t}\,ph \tan\frac{\alpha}{2} \qquad (9)$$

$$\text{and} \quad R = \frac{v}{t}\,ph\,\frac{m}{\sin\alpha} \qquad (10),$$

equation (8) may be written in the following form :

$$f = ph - Q - R;$$

and, by examining the derivation of equation (8), it will appear that

$$Q = ql \times FC', \text{ and } R = ql \times C'D.$$

Consequently Q represents the amount of the longitudinal friction of the water on the cable when it is laid without slack ; and R, the longitudinal friction on the slack alone.

Calling P the force which retains the cable on board when it is paid out so as to be laid without slack, we have :

$$P = ph - \frac{v}{t}\,ph \tan\frac{\alpha}{2} = ph - Q \qquad (11).$$

To obtain a fuller account of the influence of v, the speed of the ship, upon the values Q and R, an examination of the values of P, Q, R, f, and α in the case of an Atlantic cable are here given. According to Longridge and Brooks the constants of this cable are :

p = 0.336 pounds to the foot,
t = 22.96 feet per second,
u = 3.28 feet per second.

If we suppose the cable to be laid in a depth of 1330 fathoms with a slack of 10 per cent., P, Q, R, f, and α will have the following values for velocities of the ship ranging from two to ten knots per hour :

v	2 Knots.	4 Knots.	6 Knots.	8 Knots.	10 Knots.
	lbs.	lbs.	lbs.	lbs.	lbs.
P	2872.2	2866.1	2865.9	2865.7	2866.4
Q	214.3	220.4	220.6	220.7	220.1
R	56.1	187.3	408.0	716.5	1114.1
f	2816.1	2678.7	2457.9	2149.2	2149.2
α	54°-50′	28°-05′	18°-55′	14°-15′	11°-25′

ph = 3086 lbs.

From the above table it will appear that the restraining force of the brake and the longitudinal friction of the water are, when the cable is laid without slack, almost independent of the speed of the ship, but remain proportional to the depth, h ; that the longitudinal friction on the slack of the cable is proportional to the square of the speed of the ship; and that the effective hold to be exercised by the brake diminishes at the same time that the friction increases in such a manner that the sum of these two forces remains about constant for variable values of v. It also appears that the angle of immersion of the cable diminishes rapidly as the speed of the ship increases.

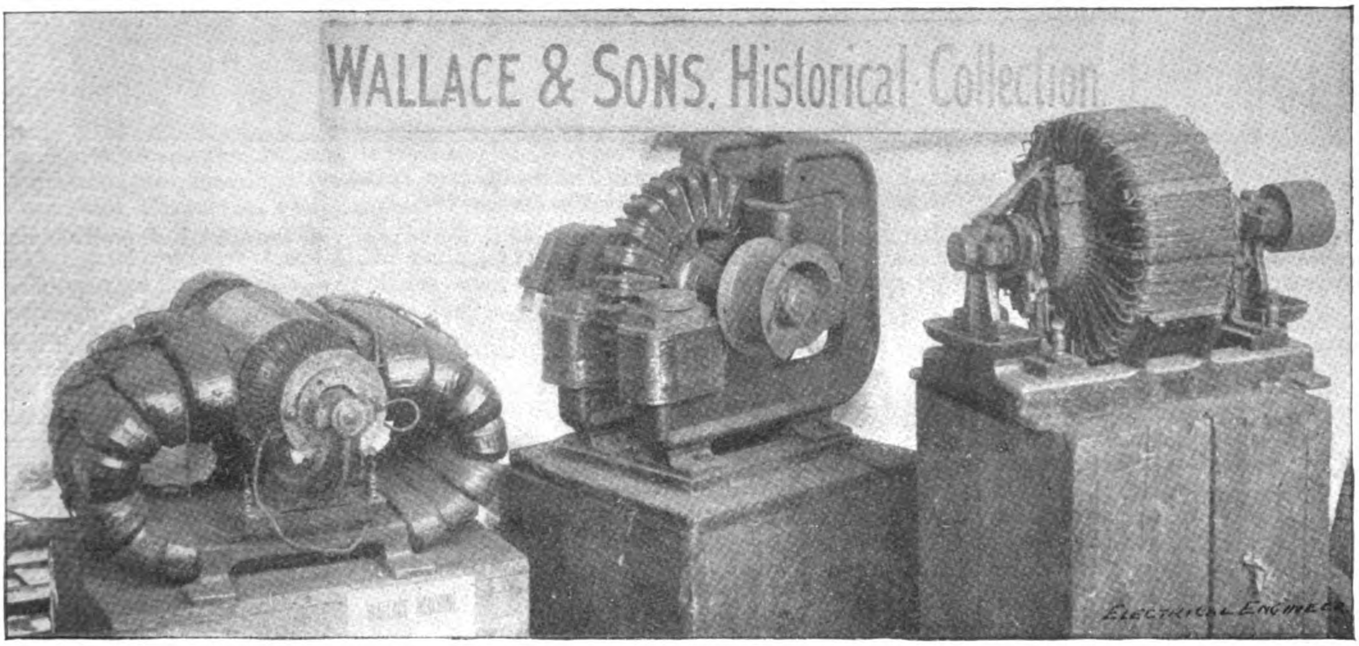
WILLIAM WALLACE, AND HIS CONTRIBUTIONS TO THE ELECTRICAL INDUSTRIES.[1]—III.

BY

Wm. J. Hammer

VII.

Another type of low tension dynamo was constructed by Mr. Wallace in 1876 for the Western Union Telegraph Company to take the place of batteries. The armature consists of a series of coils mounted side by side on the shaft in a manner identical with the Crompton-Burgin armature of England to which it bears a striking resemblance and which it antedates.



WALLACE'S DYNAMOS OF 1878 AND 1879.

The cut here represents three of many types of experimental dynamos built by Mr. Wallace. The one to the right of the illustration was constructed in 1879 in conjunction with Mr. Henry Edmunds, now of London, but at that time in Mr. Wallace's employ. It has a double-wound Gramme ring with two commutators and a circular field enclosing the armature. The machine in the centre was also built in 1879, and shows a peculiar form of field and an armature of the Pacinotti type. To the left is shown a dynamo not unlike in general construction an inverted Mather machine, as made to-day. The field magnet consists of a huge horseshoe magnet wound in sections and an armature of the Siemens type. The old machine of Prof. Jurgensen, of Copenhagen, is even more like it in appearance. It was built subsequently to Wallace's and is mainly interesting because it employed internal magnets to act on the inner windings of the Gramme ring armature. This was constructed on Feb. 2, 1878. It is interesting in examining the early machines made by Mr. Wallace to note the steps taken to increase the efficiency of the machine, which more extended knowledge of both theory and practice to-day enable us to endorse most highly. As examples of this, note that the armature of the Telemachon dynamo, had its core made of laminated plates, which is claimed to be the first ever made thus, and in the centre dynamo on this page note the form of the field and the method of winding the coils so as to bunch the greatest number of turns as near the end of the pole-piece as possible. Note also the application of the rocker arm to the 1874 dynamo, and other features which will suggest themselves upon an examination of the cuts shown.

VIII.

One of the most important projects carried out by Mr. William Wallace, in conjunction with his brother Thomas, was the construction of the enormous electro-deposition plant adjoining their works in Ansonia, for the purpose of plating with copper the steel wire used by the Postal Telegraph Company in conjunction with Prof. Elisha Gray's Harmonic Telegraph between New York and other large cities, notably Washington, Chicago and St. Louis. The circuit to St. Louis, via Chicago, was 1,300 miles in length, and consisted of two wires each, with 200 pounds of steel core and 500 pounds of copper plating per mile. The actual length of line from New York to Chicago was 1,027 miles, and in view of the widespread interest manifested in the recent opening to the public of the line of the Long Distance Telephone Company between New York and Chicago, 960 miles in length, it is interesting, historically, to note that the steel cored copper wire of the Postal Telegraph Company was telephoned over from this city to Chicago almost ten years ago, as is shown by the appended extract from the diary of Mr. H. Cummins, at that time vice-president and general manager of the Postal Telegraph Company, under whose entire charge and supervision the lines of the company were:

> "Sunday, March 25, 1883. To-day we got our wire connected to Chicago on the Postal Telegraph line. It tested 1,522 ohms resistance, much better than we expected. Prof. Gray and I talked

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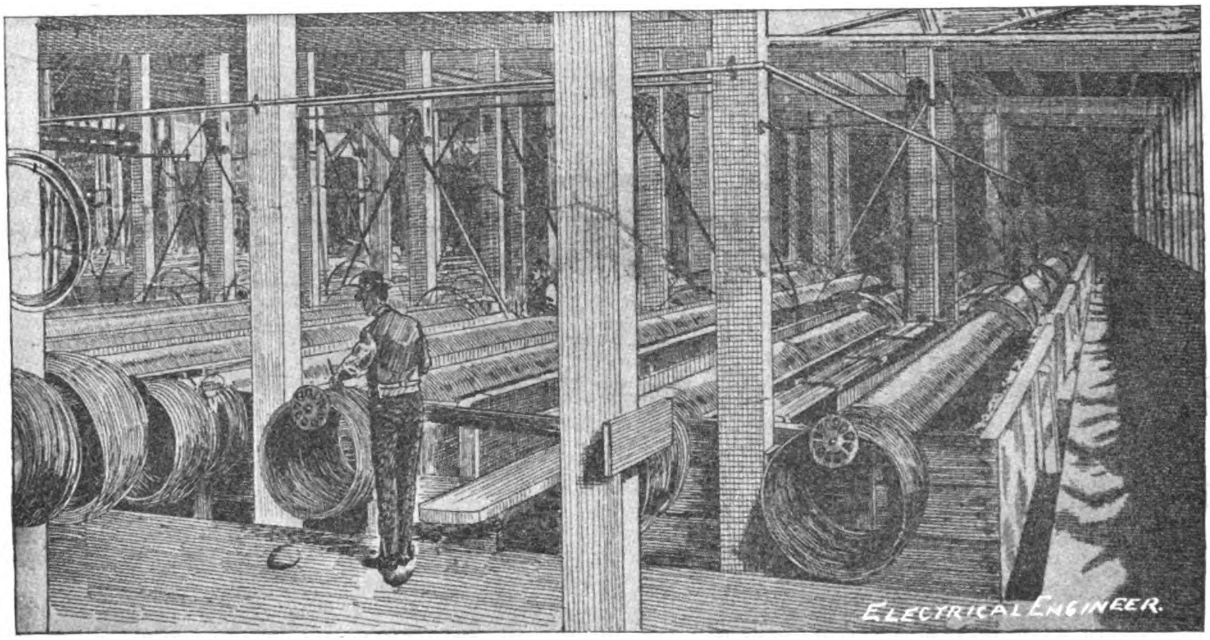
[1] Copyright, 1898, by W. J. Hammer.

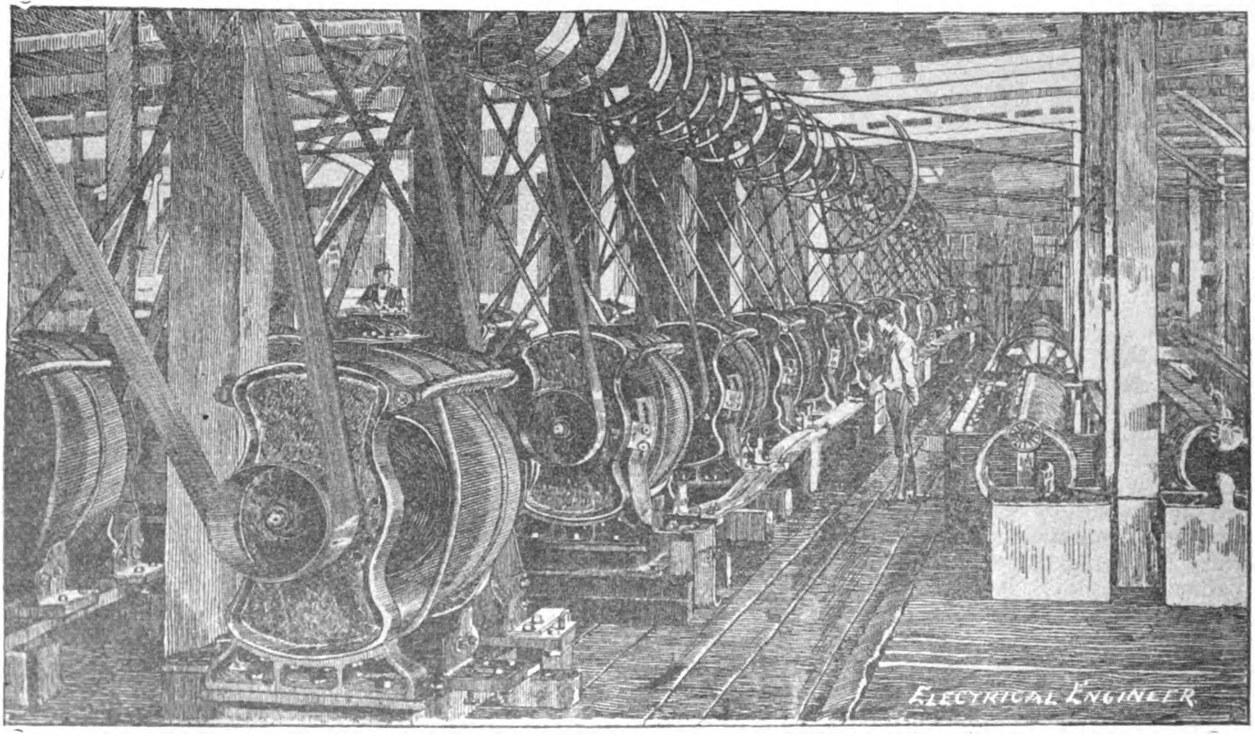
with Theo. F. Taylor in Chicago by telephone over the wire, the greatest feat ever accomplished. I received the first message over the line. This is a great day for me, two years' hard labor now crowned with great success, even beyond my sanguine expectations. Whipple and Pogue were also present and much enthused. I breakfasted with Whipple at Taylor's Hotel, Jersey City. Roberts called on me in the evening at my house and we discussed my program with the Bell Telephone Company people."

Subsequently many prominent people telephoned over this line and at different periods since telephone experiments have been conducted, notably at the time of Van Ryssellberghe's visit to this country about seven years ago.

It is also interesting to note that not only did Mr. Wallace manufacture this wire, but the greater portion of the hard-drawn copper wire used in the circuit now established for the Long Distance Telephone. Thanks to various parties, and especially Prof. L. H. Laudy, of Columbia College, a warm friend of Mr. Wallace, I have secured some interesting data relative to the capacity of the electric deposition plant referred to above.


ELECTRICAL ENGINEER.

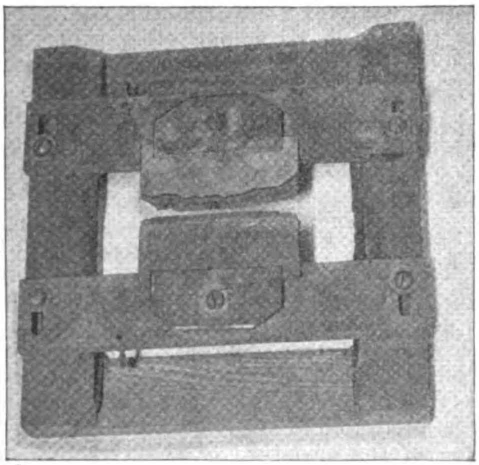
WALLACE & SONS' ELECTRO-DEPOSITION PLANT—PLATING TROUGHS.
(Fac-Simile Reproduction From New York Daily Graphic.)



WALLACE & SONS' ELECTRO-DEPOSITION DYNAMO PLANT—DYNAMO DEPARTMENT.
(Fac-Simile Reproduction From New York Daily Graphic.)

IX.

The accompanying illustrations on this page, which appeared originally in the *New York Graphic*, and are, I believe, the only illustrations ever made of this marvelous installation, give a slight idea of the dynamo plant and the arrangement of the plating baths. The former consisted of not less than 31 huge Wallace dynamos, each capable of raising to a white heat 18 feet of No. 4 copper wire, and Prof. Barker and others inform me that so powerful was the current produced by one of these enormous machines that an eight inch iron bolt held in the hand under the copper rods leading from the dynamo was drawn to it and remained attached thereto. There were in all 180 troughs, each holding 180 gallons of $CuSO_4$ solution, in all 32,400 gallons. Suspended in each trough were 1,700 pounds of copper anodes, making a total of 300,000 pounds in the 180 troughs. The anodes were suspended at the sides of the tank from a heavy copper bar, 3 inches by ¾ of an inch, which ran from end to end of the tank. The cathode was represented by the steel wire which was fed spirally in at one end of the tank over a revolving copper cylinder or tube suspended above and not in contact with the sulphate of copper. As the tube was connected with one terminal of the plating machines the wire which was itself submerged in the solution received during its passage its heavy coating of copper. Over 100 miles of steel wire at a time were thus treated. An arrangement similar to a huge glass comb was placed on each side of the tank and kept the spirals an equal distance apart. This plant, doubtless the largest of its kind ever constructed, is to-day but a reminiscence. It was purchased from Messrs. Wallace & Sons by Mr. John W. Mackay, representing the Postal Telegraph Company. Shortly after its introduction by Wallace & Sons, hard-drawn copper wire, possessing not only the necessary tensile strength, but high conductivity as well, (notwithstanding the prevailing impression at that time that hard-drawn copper must of necessity be of far lower conductivity than soft copper) was found to obviate the use of steel-cored copper wire, which was necessarily much more expensive; and soon thereafter the plant was re-sold and consigned to the scrap heap.



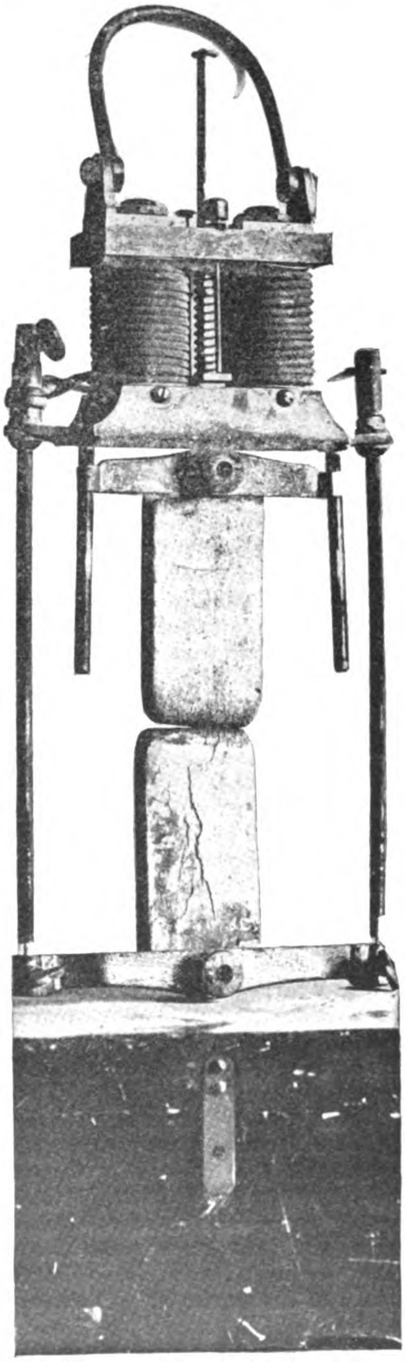
The First Arc Lamp Made in America.

In this connection it is interesting to show a comparison between the resistances of hard and soft-drawn copper wire. A piece one metre in length and one millimetre in diameter of chemically pure copper at 0° centigrade will measure when annealed 0.02034 Legal or Paris Ohm, and the same hard-drawn will measure 0.02081 Legal Ohm.

X.

Mr. Wallace invented and constructed the first arc lamp made in this country, an illustration of which is shown on this page. It consists of two plates of battery carbon fastened in a wooden frame, the carbons being fastened to cross-pieces near the top and bottom of the frame by broad brass clamps and screws. The carbons could be adjusted by hand as indicated by the slot and supporting screws observable in the ends of each cross-bar; although Mr. Wallace informs me they usually kept a small boy with a hammer busy going from lamp to lamp and driving the plates together. This form of regulator for an arc lamp it suffices to say was not patented. The arc was established by means of a piece of wire or carbon drawn across the edges of the two plates, after which it would continue to burn for a long time, the arc moving lengthwise across the plate, constantly seeking the path of least resistance.

This lamp was constructed early in 1875 and shortly thereafter Mr. Wallace replaced the wooden frame by a metallic one. The two slides in the frame each held a carbon plate 12 inches long by 2½ wide and half an inch thick. These slides and carbon holders were insulated from one another, the upper one being connected with an electromagnet in series with the carbons which by its action on an armature and clutch separated the carbons and established the arc as soon as the circuit was closed by gravitation. This lamp was a remarkable improvement in simplicity and economy as compared with the intricate and



One of the First Four Arc Lamps Ever Run in Series.

expensive lamps constructed abroad by Serrin and others; the Wallace lamp would burn for 10 nights of 10 hours each. Mr. Wallace has the distinguished honor of being the first person to run arc lamps in series, and on page 159 is shown one of the first four lamps ever burned in this manner. They were used for several months in the works of Wallace & Sons, and this particular lamp is now in the possession of Columbia College and exhibited among its most valued scientific treasures. I am indebted to Prof. L. H. Laudy for the photo shown, which he kindly took for me. In this connection, I may add that one of Mr. Wallace's first dynamos was sent to Columbia College for the School of Mines, and was used there for electrical projection for spectrum analysis with the arc. Prior to that, the School had used primary batteries. The dynamo is to-day one of the prized possessions of the School of Mines.

LAMINATED OR DIVIDED IRON AND OTHER METALLIC MASSES IN ELECTROMAGNETIC APPARATUS.—VII.

BY

Thos D Lockwood

Edward Weston.

RETURNING to English patents we have to mention four issued in 1877. These are: No. 4432, Nov. 24, J. Rapieff; No. 4435, Nov. 24, S. A. Varley; No. 4464, Nov. 27, L. Simon; No. 4903, Dec. 27, W. R. Lake. The last two patentees, are simply attorneys; Simon representing S. Shückert, and Lake representing Weston.

The Rapieff patent is an enormous affair of 42 pages, but as respects the generator which it describes, it points out that: "To obviate the inconvenience of retarded magnetization due to mutual induction in systems of bobbins, the cores of such bobbins are made up of a series of thin electromagnets with their like poles similarly placed." In Varley's patent, the revolving bobbins have each a wooden core surrounded with a number of iron wires arranged parallel to the axis of the core. The Shückert machine, being a modified Gramme—with its ring made up of rings—makes its first appearance in the Simon patent. Its sheet iron component rings are insulated magnetically from each other. The Lake patent is simply the English version of one of the several Weston patents to which reference has already been made.

The laminated or divided iron core idea is shown in the following four British dynamo machine patents of the year 1878: No. 2003, May 18, H. J. Haddan; No. 3658, Sept. 17, J. H. Johnson; No. 4844, Nov. 27, I. L. Pulvermacher; No. 5139, Dec. 14, W. B. Brain.

The Haddan patent may be dismissed from further consideration by the statement that it is simply the English patent for the Brush machine. The Johnson patent describes the well-known and important De Meritens machine, the armature of which is composed of a brass ring around which are coils with soft iron segmental cores, separated by diamagnetic partitions, which cores are built up of a great many thin plates stamped out of sheet iron. The Pulvermacher dynamo consists of two horizontal and concentric cylinders built up of a number of soft iron rings bolted together; and in the Brain dynamo, the armature is composed of a ring made up of sheet iron or wire.

In 1879, I find but a single British patent requiring notice. This is a second patent granted to L. Simon, for the Shückert machine, No. 960, of March 11.

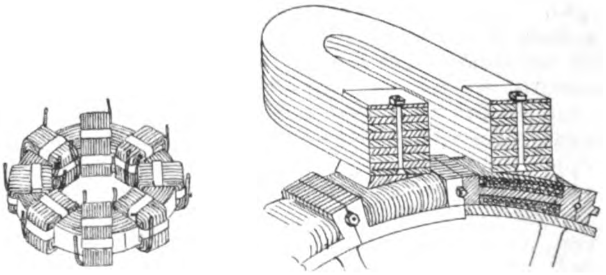
The armature core is a flat ring and is built up of several sheet iron discs magnetically insulated from one another.

In 1880, also, but one dynamo appears which conspicuously shows divided iron. This is the British patent on the Edison machine which has already been noticed in connection with its U. S. Patent. Our list of the British patents involving the feature of division closes with No. 253 of January 20, 1881, to Charles G. Gumpel; No. 3,362 of August 3, 1881, to John Hopkinson; and No. 5,665 of Dec. 24, 1881, to S. A. Varley, two of which are for dynamos, the other being for a self-induction coil.

Of these, the first shows among other things a dynamo armature which, the specification says, may be made "either in one solid piece or built up of sheet, wire, hoop or other convenient form of iron"; and one of the forms illustrated shows it as being constructed of a number of "iron rings *electrically insulated from* each other."

The Hopkinson patent is for a coil in which the counter E. M. F. of self-induction is used for purposes of regulation. Fig. 8 shows one of the patented forms of the coil. This form has a ring-shaped iron core, coiled from a ribbon of sheet or hoop iron, and having a layer of insulating material between the layers of iron. Coils of covered wire are slid over this ring. The patentee identifies the laminations of this core with the wires of other cores by saying: "Instead of an annulus of sheet iron, iron wire may be used, wound after the manner employed in the construction of the armature of the Gramme machine." By the same remark, he also identifies the relation of divided cores in dynamos, with divided cores in induction coils.

In the Varley patent the armature of a dynamo is made up of a number of bobbins. The bobbin cores are constructed of a series of thin plates of iron arranged side by side, magnetically insulated from one another by pieces of paper or other suitable insulating material placed between the plates.



FIGS. 8 AND 9.

French patents referring to the necessity of dividing the iron of armature cores are: No. 109,573, Sept. 11, 1875, Burgin; No. 120,649, Oct. 8, 1877, Gramme and d'Ivernois; No. 126,652, Sept. 23, 1878, Le Bailly; No. 127,385, Nov. 12, 1878, Bertin and Mersanne.

The Schückert machine, with its laminated ring is quite fully discussed in *Dingler's Polytechnisches Journal* (Vol. ccxxiii, p. 587, 1877) and in the *Telegraphic Journal*, (London, Vol. v, p. 105.) The latter periodical commenting upon the construction of its armature has to say: "Again, the iron ring is not in one massive piece, but in several ring discs, separated from each other by ebonite, pasteboard, or the like, the whole ring being held together by brass rivets. The object here is to hasten the disappearance of remanent magnetism in rapid change of the poles, and to obtain the maximum of magnetization." *The Journal of the Telegraph*, New York, also makes a similar note (Vol. x. June 1, 1877, p. 163).

The De Meritens machine was brought prominently before the public in 1878, and is well described in many publications of about that time. Its armature, Fig. 9, is a wheel made up of a number of segmental pieces each separately wound with the generating coils, and all being joined together by suitable bolts, yet magnetically insulated by interposed pieces of copper. Each of these segmental pieces is made up of thin plates of iron cut out and placed together to the number of 50, each one millimeter thick. This point, as well as its reason, is noted in *Telegraphic Journal*, London, (Vol. vi, Oct. 1, 1878, p. 397); *Electrician*, London, (Vol. ii, Dec. 7, 1878, p. 29); "Electrical Illumination," Dredge, (Vol. i, pp. 188–201) from which we take the figure; "Lighting by Electricity," a Blue Book published by the British House of Commons in 1879, p. 247; "Electric Lighting," Du Moncel, (London Translation 1882, p. 56); "The Electric Light and its Practical Applications," Paget Higgs, (London 1879, p. 113); and in many other works relating to the electric light, and to dynamo-electric machinery.

The *Journal of the Telegraph*, commenting on a United States patent granted for a telephone whose magnet-core was made up of small wires, refers to the works of Page and Sturgeon, and then adds :—"Ever since that time the magnets of induction apparatus have been constructed in this manner. Upon the same principle, the magnets of the printing instruments and relays used by the Gold and Stock Telegraph Company, have been for many years made with split cores, the advantage of so doing having been shown by the experiments of G. W. Dean of the Coast Survey, upon the transmission of longitude signals through repeaters ;" (C. S. Report 1865); (*Jour. of Tel.*, Vol. xi, Jan. 16, 1878, p. 21.)

Culley calls attention to the necessity for slitting metallic tubes surrounding electro-magnets, and metallic bobbins on which their coils are wound; and speaks of the advantages of grooving or slotting solid iron cores for electro-magnets, and of the use of fine insulated iron wires in cores; ("Handbook Practical Telegraphy," Seventh Edition. London, 1878, p. 76, and p. 100). Other accounts of the laminated Schückert ring armature may be found in Schellen's "Die Magnet: und Dynamo Elektrischen Maschinen," Köln, (1879, p. 141); *Telegraphic Journal*, (London, 1879, pp. 118–119); and Dredge, "Electric Illumination," (Vol. i, p. 299).

Cance in his dynamo also recognizes the value of the lamination principle. It is described by the *Telegraphic Journal* as being of the same general class as the Niaudet machine, each bobbin being "composed of a bar of soft iron formed of a number of iron wires, well annealed and very soft; on these are coiled two layers of insulated copper wire, and then a second wrapping of the same dimensions as those forming the core, etc.;" (*Telegraphic Journal*, London, Vol. viii, Oct. 15, 1880, p. 346).

On Feb. 26, 1879, Mr. E. A. Cowper read a paper on "The Writing Telegraph" before The Society of Telegraph Engineers, London, in which, referring to the receiving instrument he says :—"The stationary electromagnets are *laminated, being made of very thin iron plates, such as I employed in an electromagnetic machine used by my father to spin cotton on the lecture table at the Royal Institution in* 1838, *as such plates almost entirely do away with residuary magnetism.*" (*Jour. Soc. Tel. Engrs.* Vol. viii, 1879, p. 145).

Dredge mentions the lamination feature of the Siemens, Jürgensen, and Fein machines, ("Electrical Illumination," Vol. i, 1882, p. 282, p. 302 and p. 307).

For the sake of making this record as complete as possible, references to such other publications as are mentioned in articles which relate to this subject, but which themselves have not been accessible for personal examination, are here given.

They are: *Poggendorff's Annalen der Physik:* For 1836, Vol. xxxviii, pp. 417–444; 1839, Vol. xlviii pp. 95–106; 1841, Vol. liv, pp. 312 and 315; 1842, Vol. lvi, pp. 251–268 and 268–274; 1851, Vol. lxxxiv, pp. 181–213; 1854, Vol, xcii, pp. 220–237; Vol. xciv, p. 296; Vol. xcvii, p. 261.

Silliman's American Journal of Science and Art: For 1841, Vol. xl, p. 201.

Dingler's Polytechnisches Journal: For 1870, Vol. cxcvii, pp. 133–135.

Comptes Rendus: For 1871, Vol. lxxiii, p. 922.

"Anwendung des Electromagnetismus," Berlin, 1873, pp. 158–160.

SOME EXPERIMENTS WITH DISRUPTIVE DISCHARGES.

BY

Alexander Jay Wurts.

A circular recently sent to me, describing a new spark-gap arrester containing a coil in the discharge circuit, makes the two following statements. First: "When a statical discharge takes place and the line is struck, the lightning, of course, seeks the most direct outlet to earth, and that is through the arrester, for the resistance of this whole apparatus from line binding post to ground is less than one-sixth ($\frac{1}{6}$) of an ohm." The second statement is: "It might be thought that this coil offers some resistance to the passage of the lightning, but it does not offer any more than a straight conductor of the same cross section and length, for the core, or armature, is not inside the winding until after the passage of the lightning. There is no self-induction in this arrester, as some might suppose, for there is no current flowing through the coil until after the passage of the lightning, and the passage of the lightning is instantaneous and it cannot produce induction to hinder its own passage." This arrester is also described in The Electrical Engineer for Dec. 14, 1892.

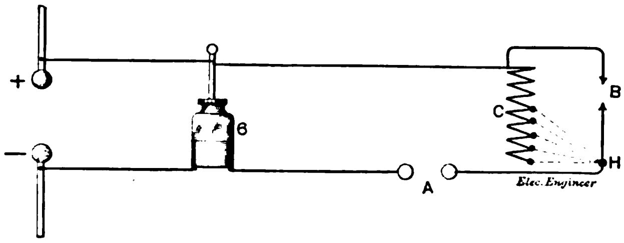
The first of these two statements, in speaking of the ohmic resistance from line to ground being less than one-sixth of an ohm, can hardly be correct, for if even the smallest spark-gap were included, the resistance would then be practically infinite. If, however, it is only the resistance of the coil that is considered, then, either the wire of which the coil is made must be very fine (assuming that it is made of copper) or if it were even as large as No. 7, its length would be considerable, for the resistance of 1,000 feet of No. 7 copper wire is .150 of an ohm. If this coil is four (4) inches in diameter and contains 1,000 feet of wire it would then consist of about 1,000 turns. I will presently describe some interesting experiments that I have made, and the reader will then judge for himself whether this arrester offers any considerable resistance to the passage of disruptive discharges such as occur during thunder storms across the spark-gap of an arrester when connected to overhead wires.

The second statement is well covered in Mr. Wm. Turbayne's article, published in The Electrical Engineer for Dec. 28, 1892. Mr. Turbayne has, however, made statements without giving the practical illustrations which are so necessary in order to carry conviction to the vast majority of men particularly interested in this subject, and who, although fairly well posted in the fundamental principles of electricity, are wholly ignorant of the more intricate problems, seldom studied outside of the laboratory. The experiments which I am about to describe are intended to illustrate facts in a simple, comprehensive manner, and without the technicalities and formulæ which so often accompany matter of this kind and draw but a passing glance from the "practical man."

The apparatus and connections used are clearly shown in the accompanying figure, in which "+" and "—" represent the two terminals of a Toepler-Holtz influence machine. "6" is a battery of six one-half gallon Leyden jars. A is a $\frac{12}{32}$ inch spark-gap between two brass ball electrodes, each $\frac{1}{2}$ inch in diameter. C is a coil of wire, the material and dimensions of which are changed according to circumstances. The specifications for this coil will be given for each test. B is a spark-gap, which may be adjusted at pleasure. It is connected in shunt to coil C and consists of blunt points made from $\frac{1}{2}$ inch brass rod.

The object of the influence machine, "+" and "—," is to statically charge the battery of jars, "6". The object of the jars is to accumulate a sufficient quantity of static electricity to produce a violent disruptive discharge. The object of the spark-gap A is to cause a disruptive discharge to take place through the coil C, or across the gap B, as the case may be. The object of the gap B is to determine the relative resistance offered by the coil C to a given disruptive discharge, by adjusting the distance between the confronting points till the discharge shall just leap the gap, in preference to passing through the coil. The object of changing the dimensions and material of coil C will be understood as we proceed. The object of each test is to determine the length of spark-gap at B that a disruptive discharge, such as would occur at A, will rather leap, than pass through a coil placed at C. In other words, the length of the spark-gap B, as given in the following table, is a comparative measure of the resistance offered by the coil to the disruptive discharge.

The first coil placed at C was made of No. 14 German silver wire. It was $\frac{9}{16}$ inch in diameter and contained no core. The number of turns included by the circuit B was varied by connecting the point H to different points in the coil. The following are the results obtained: The numbers under column C indicate the number of turns used in coil C; the numbers under columns B (1) and B (2) indicate the number of thirty-seconds of an inch that the disruptive discharge would prefer to jump rather than pass through the specified number of turns in coil C. From the connections indicated it will be evident that the discharge will have a choice between the path C and the path B.



C	B (1). German silver.	B (2) Copper.
82	11.	14.
77	10.75	13.5
72	10.50	13.
67	10.25	12.5
62	9.75	11.75
57	9.50	11.25
52	9.25	10.75
47	8.75	10.25
42	8.25	9.75
37	7.75	9.
32	6.75	8.
27	6.25	7.25
22	5.25	6.25
17	4.25	5.
12	3.25	3.25
7	1.50	1.75
2	.50	.50

Thus it will be noticed that the disruptive discharge, rather than pass through 82 turns of this German silver wire coil containing no core, will jump about $\frac{1}{3}$ of an inch. This coil being made of German silver had a high ohmic resistance compared with a similar coil made of copper. But this resistance plays no appreciable part in impeding the passage of the discharge, as will seen from the following.

The next test was made with a copper coil of the same sized wire as the German silver, and was supposed to have the same dimensions; as a matter of fact, however, it was a shade larger in diameter. The results obtained with the copper coil are given in column "B (2)."

It will thus be seen that the copper coil, in spite of its low ohmic resistance, offered even a higher resistance to the passage of the discharge than did the German silver coil. But this increased resistance is no doubt partly due to the slightly increased diameter of the copper coil over that of the German silver coil; for, the greater the diameter of a coil the greater will be the resistance offered to the passage of a disruptive discharge. To demonstrate this fact, I connected at C a coil 8 inches in diameter, consisting of 19 turns of No. 4 copper wire, and found the "B" spark to be 21.

Not having the dimensions of the coil in the above-mentioned arrester, I am unable to give the comparative resistance that this arrester will offer to the passage of a disruptive discharge. Assuming, however, that the coil is 2 inches in diameter and contains only 100 turns, it will be evident from the above figures that the arrester will offer a very difficult path to the passage of disruptive discharges. In view of this fact the possibility of fine adjustment in the spark gap, also claimed for the arrester, amounts to nothing at all.

Now an increase in the length of the spark gap at A will cause the battery of jars to discharge at a greater difference of potential; the amount of charge will be greater, and consequently that of the discharge. With every increase in the intensity of the discharge at A, there is considerable increase in the B value for any given coil C. It is, therefore, fair to assume that the B values found in these experiments will be considerably larger when the conditions are such as are usually experienced during thunder storms.

Having thus far illustrated facts, it will now be proper to explain that a disruptive discharge is oscillatory in its character; that is, it is similar to an alternating current of very high frequency, and it consequently meets with self-induction in its passage through wires. The frequency developed in a disruptive discharge is, however, vastly greater than that developed by an alternating current dynamo, and the inductive resistance, being proportional to the frequency, is also enormously greater; this fact, therefore, accounts for the high resistance offered to discharges of this kind by even a few turns of large copper wire.

The inventor of the above mentioned arrester is also mistaken in his assumption that the coil of the arrester offers less resistance when the iron core is out than when it is in, for the oscillations of the discharge are too rapid to affect the iron. Consequently, there is no increase in the self induction when the iron is in, or, if there is, the effect is so insignificant that it is more than compensated for in the Foucault currents set up in the core. These Foucault currents will of course act as a closed secondary and tend to reduce the inductive resistance of the coil. In fact, with the above mentioned copper coil made of No. 4 wire, and with which B was found to have a value 21, the introduction of a bundle of iron wires into the interior of the coil caused the resistance to decrease and gave a B spark equal to 17.

In order to demonstrate that there was no perceptible magnetic action due to the presence of the iron core, in other words, that the same results would be obtained with a non-magnetic metal, I coated the inside of the coil with tin foil, and on again measuring B found it to be 17, as before. The tin foil formed a secondary to the coil and therefore reduced its inductive resistance. If the ends of the tin foil coating made poor contact, a brilliant spark would appear at that point each time a discharge passed through the coil, and a hole was burned in the foil. The Foucault currents in the bundle of iron wires manifested themselves by a beautiful display of scintillating sparks between the wires of which the bundle was made. Upon repeatedly passing the discharge through the coil, however, the scintillating sparks gradually decreased, but at once reappeared when the iron wires were connected to earth. A slight shock was felt on touching them with the hand. There is thus static as well as dynamic induction between the coil and its metal core.

It is curious to note that the coil described in connection with the above mentioned arrester as offering no resistance to the passage of the discharge forms one of the principal features in the "Tank Arrester," (see THE ELECTRICAL ENGINEER, Nov. 16, 1892) for preventing disruptive discharges from reaching the generator; in fact, such a device is commonly called a "choke coil."

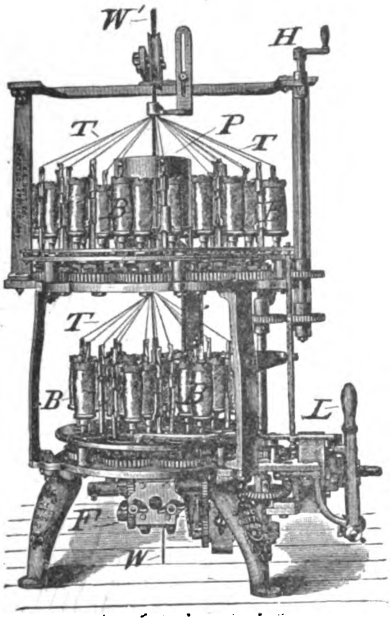
In a subsequent article I shall continue these practical illustrations, showing the impedance offered by comparatively straight wires; the necessity for using a large number of line arresters, in order to form an efficient protection for electric circuits; also the best means and materials for making lightning arrester connections to earth.

INSULATED ELECTRIC CONDUCTORS.—XVIII.

BY

James Bowstead Williams M.A.C.

Weatherproof Wires.—The simplest form of a painted weatherproof wire is one having a covering or dielectric formed of one or two braids saturated with paint; and because the covering is apparently so simple it is usually one of the poorest made. The principal reason for this is that the common process of manufacturing such coverings consists in (1) forming two braids on the wire, and (2) soaking the braids in paint. This work, on account of its apparent simplicity, is often entrusted to inexperienced hands whose duty it is to see that the braiders work properly and that the braided coverings go through paint; that being done, their responsibility and interest in the matter are at an end. Weatherproof wires, if properly made, will do good service, but their production requires care, and a knowledge of insulating material. The process of manufacture of a good weatherproof wire involves several steps which will be considered in the proper place.



DOUBLE BRAIDING AND INSULATING MACHINE.

To illustrate the method of manufacturing any kind of painted wire, that one mentioned at the beginning of this article will be selected. For this work a braider such as is shown will be required. In the engraving, W represents the naked wire; W' the same wire after it has been covered with two braids; T - - - T are the separate threads or yarns, wound on the bobbins, B - - - B, and which are united to form the braids; P is a vessel containing paint, and provided with a stuffing box at the lower end, through which the wire passes and which prevents escape of the paint; H is a handle for operating the braider by hand while making adjustments, threading the bobbins, etc.; L is the mechanism for throwing the machine in and out of gear; and F is the feeding device for the wire.

The dielectric is formed in the following manner: The wire W, previously straightened and reeled, is drawn off the reel by the action of the feed F, which consists of two grooved adjustable rolls, having their grooves scored so that they will grasp the wire without slipping, which revolve in opposite directions by means of suitable gearing. The feed then pushes the wire upwards, and the lower set of bobbins throws the first braid consisting of 16 strands, upon the wire. The wire, thus covered, passes through the paint in P when the first braid is soaked with the paint. Continuing upwards, the soaked braided layer is covered with a second braid, formed of 24 strands, by the upper set of bobbins. After the wire has received its second braid it is taken off on reels. The push-up feed is necessary for this kind of work, for if the ordinary take-up device—such as is shown on the braiders in No. XV of this serial—were used the wet braided layers would become flattened or lose their circular form by pressure on the wheel around which the wire is wrapped and which *pulls* the wire through the machine. Even after W' leaves the machine it must be carefully drawn along and reeled in order to avoid compressing the braids.

If we examine W' we will find that the inner braid is apparently saturated with paint and that some of the paint which adheres to this braid as it leaves the vessel has entered the interstices of the outer braid and has also stained, wholly or in part, the fibre. As it is practically impossible to complete the saturation of the covering in a machine like that shown, the outer layer—supposing that the inner layer is fully saturated and the spaces therein filled—must be finished by passing W' through some kind of liquified insulating material, whether paint or a melted compound. This may be done immediately after it leaves the braider, or the wire may be laid aside until the inner layer becomes dry and then finished. This subsequent soaking is often advantageous, for if there are vacant spaces left in the inner layer after it has hardened, the liquid material, besides completing the outer layer, may enter into and fill these spaces. At any rate, it can be *made* to do so.

The foregoing description is that of a process of manufacturing the simplest kind of painted weatherproof wire which is extensively used; what its disadvantages are will be mentioned later.

Painted dielectrics can be formed in a variety of ways. For example, the inner layer may have for its body a wrapping or tape of fibrous material and the outer a braid, the whole being saturated with one kind of paint; or the covering may consist of several braids, each braid being saturated with the same or a different kind of paint. Theoretically, there is no limit to the number of decks—each deck forms a separate braid—and paint vessels a braider may have, but practically there is, and the limit of usefulness is reached in a triple deck machine; for the time consumed in repairing broken threads, threading the machine, etc., barely compensates for the increased number of layers.

ELECTRIC POWER TRANSMISSION AT NEUCHATEL, SWITZERLAND.

THE department of public works of the city of Neuchâtel has instituted an international competition for designs for an electric transmission plant by means of which the water power at Pré aux Clées is to be made available at Neuchâtel, some 5⅛ miles distant. Turbines and generators to be installed at Pré aux Clées, the minimum water power available being 952 h. p., and the maximum 2,800 h. p. The competition was closed on Jan. 15, 1893. The prizes offered for the best three designs were 5,000, 4,000 and 3,000 francs. The judges were Dr. Hirsch, of the Neuchâtel Observatory, chairman; Prof. H. F. Weber, of Zurich; Prof. Colombo, of Milan; Oscar von Miller, of Munich, and R. W. Picou, of Paris.

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T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
Western Editor and Manager, L. W. COLLINS. 575 The Rookery, Chicago, Ill.
New York Representative, 208 Broadway, } W. F. HANKS.
Philadelphia Representative, 501 Girard Building, }

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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VOL. XV. NEW YORK, FEBRUARY 15, 1893. No. 250.

THE DAY OF ELEVATED ELECTRIC RAILROADS.

ENGLAND may be slow in the general matter of electric traction, but she has certainly set us an excellent example in two new fields, namely those of elevated electric railroads and of underground railroads. We have one or two quasi elevated electric roads in this country, such as that at Baltimore recently illustrated in THE ELECTRICAL ENGINEER, but we have no road like the one just opened at Liverpool and very fully treated in our Electric Railway Department this week. At present, underground electric roads do not appear to be wanted very badly by the American public, but if we are to have more elevated roads, it is certainly desirable that they should be operated electrically. The work in Liverpool differs in many ways from that which has been done in this country with the help of the trolley, and we are personally inclined to the opinion that some of our largest trolley roads as well as their passengers, would be better off, if resort had been made in the first instance to an elevated track. It stands to reason that no very high rate of speed can be permitted on the street surface. The result is that while the motor cars would easily make 15 or 20 miles an hour, they are necessarily geared down to make only 6 or 8; and hence many of the advantages of electric traction are at once sacrificed. On this Liverpool road, the schedule gives a maximum of 26 miles an hour, showing that "rapid transit" there is a reality and not something to yearn for. One thing deserves notice, however, and that is that a well built trolley road is vastly prettier and infinitely less obstructive than the Liverpool elevated road or any other elevated road that has been built. Not only so, but while in New York our elevated roads do let down a little sunlight into the streets, in Liverpool the road bed is a solid roof, with consequent darkening of the thoroughfare below.

The great gain and main advantage, after all, is in the adoption of electricity, doing away with steam, grit, dust, gas escape, oil drippings, etc., and minimizing the noise. Our American standard of 500 volts has been adopted, but there might, we think, have been an additional economy in conductors, and other elements, by the use of a higher potential, say up to 750 or even 1,000 volts. Still the Liverpuddlians are on the absolutely safe side, and that means everything in England. The work about the road and rolling stock is evidently substantial, and all the latest improvements have been adopted, including incandescents for the cars. As a whole, the road embodies many suggestions for New York, where, as in every other large city in the Union, rapid transit facilities are sadly short of the mark and far behind the age.

LONG ELECTRIC ROADS.

IN view of the fact that many of the electric street railway systems have grown to a length of over 100 miles of track, there is nothing very wonderful in the now thick-coming announcements of "long distance" roads extending across country hitherto served poorly by steam railroad or else left entirely without modern transportation facilities. But these announcements are certainly serving to attract public attention to the subject of electric traction, and indicate how thoroughly enterprising capitalists have been satisfied as to the possibilities of this comparatively new field. Last week saw the completion by Mr. J. D. Crimmins, who represents New York financiers, of arrangements by which 140 miles of road in New Jersey will be brought together in a great network reaching from the Hudson shore to the banks of the Rahway and Raritan. There is no good reason why the branches remote from New York should not in the very near future touch and interloop with a similar network spreading northward from Philadelphia. When this is done another step can be taken by filling in the reticulations, so that wherever it is worth while to have a highway, it will be an electric road. So far from being a detriment to the steam roads, these trolley lines must enormously increase their business by stimulating and populating the whole region. Similar work is already being done in New England, Ohio, Pennsylvania, Maryland, and other States.

The Berliner Patent.

THE news that the Government itself is attacking the validity of the Berliner telephone patent should not cause any great surprise. Such procedure only puts into the form of action the feeling on the part of the public and of a large section of the electrical profession that monopolies must not be perpetuated by any such means and contrivances as led to the delay in the issuance of that and kindred patents. The American Bell Telephone Company probably considered itself within its legal rights in its adoption of the policy that gives it so broad a patent at so late a day, but the Government is of contrary opinion, and is apparently convinced also that the worst thing which could happen to inventors and the patent system is the indefinite prolongation of monopolies of this kind in this way.

ELECTRIC RAILWAY DEPARTMENT.

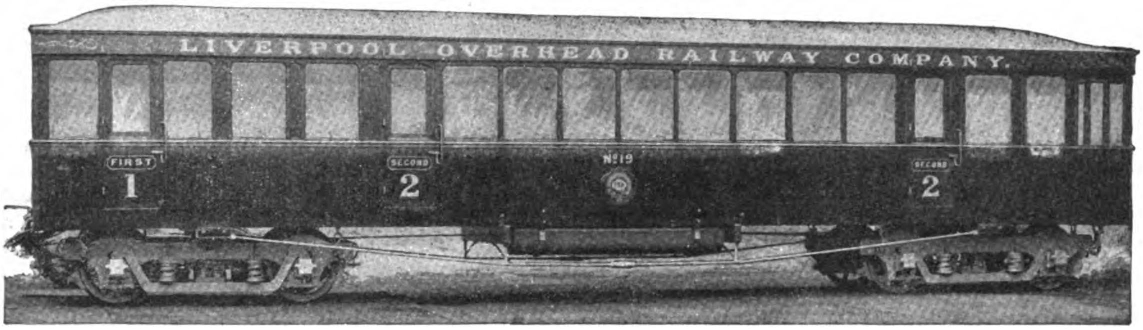
THE LIVERPOOL ELEVATED ELECTRIC RAILWAY.

BY

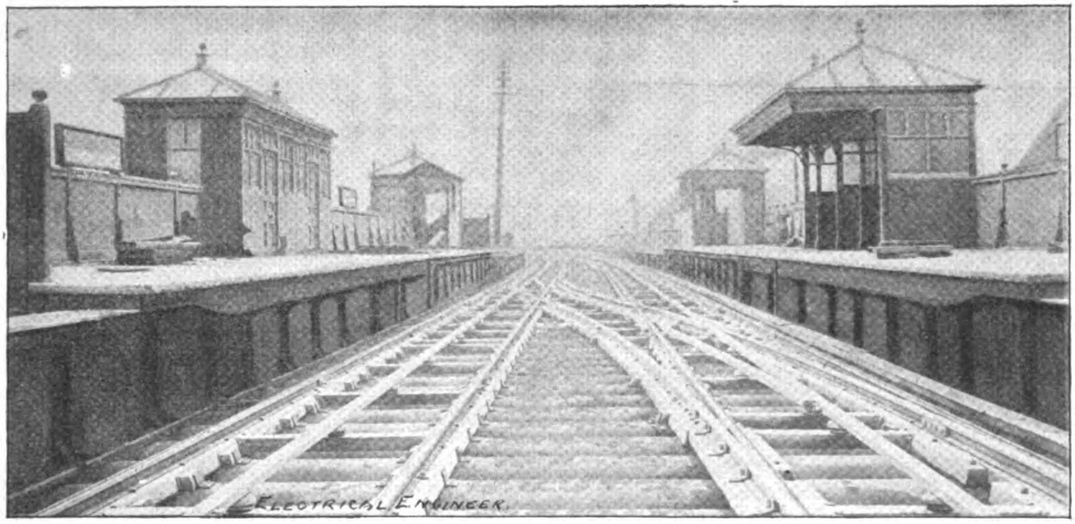
H. Scholey

I.

It can be claimed with some degree of confidence that there is a real movement in the direction of electric traction in England. Not only are there several schemes proposed which will no doubt result in something useful, but there have been recently completed two schemes which will no doubt exercise a marked effect on electric traction generally. The Liverpool Railway is an important departure in railway enterprise in England for two reasons: It is the first elevated road and the largest line equipped with electric motors.



Passenger Coach, Liverpool Elevated Electric Railway.



View of Track and Stations, Liverpool Elevated Electric Railway.

This line, which is practically ready for traffic traverses the entire length of the Liverpool Docks, a distance of about six miles, but there is nothing to prevent an extension, and, indeed, the shareholders of the concern have already been asked to sanction the raising of fresh capital for the purpose of carrying the line some three miles further. The passenger traffic along the route of the Docks is enormous and as the railway will supersede the old-fashioned 'buses there is every reason to expect that the line will be a great commercial success.

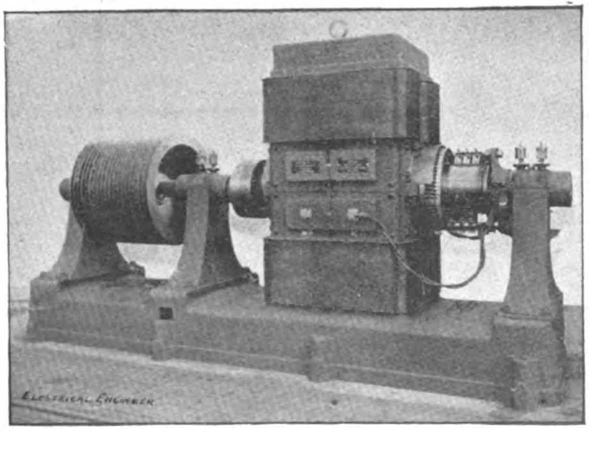
An elevated railway in Liverpool was proposed as long ago as 1852 when Mr. John Grantham proposed a scheme for a high level railway to run from the Mersey Forge to the land opposite the Huskisson Dock, a distance of about four miles. The scheme was well thought out and possessed some remarkable features. It was proprosed to use six lines, two to be used for passenger traffic, two for goods traffic, and the two nearest the docks for sidings on which the goods could be loaded and unloaded. The scheme was much thought of and many of the prominent men in Liverpool were ardent supporters of it. The Dock Board, however, refused to consider the matter seriously, and although Mr. Grantham prepared most exhaustive figures nothing was done. However, in 1877, at a meeting of the Dock Board one of the members drew attention to the delays and inconveniences arising from the increased traffic and proposed that the Board should consider the expediency of erecting an overhead steam tramway for the purpose of conveying passenger and other traffic. A scheme was then laid before the Board for a single line railway estimated to cost £150,000. After much consideration this scheme was abandoned and nothing was done for a year or two. In 1880, however, the subject came up again and after much difficulty the Dock Board secured a bill from Parliament which gave them powers to build a railway. This bill was transferred to the company which had been formed to carry out the scheme, the Liverpool Overhead Railway Company. The engineers are Sir Douglas Fox and Mr. Greathead, to the latter of whom I am indebted for many of the following details.

II.

The railway is composed almost entirely of wrought iron. With the exception of a short length, where the line passes under some coal sidings, the railway is overhead and for the most part just over the lines of the original Dock Railway, which is upon the surface. The latter railway serves for the distribution of goods by horse traction and has been used by passenger omnibuses with specially constructed wheels to enable them to leave the track when necessary. The omnibuses will now be dispensed with, for the railway will afford a means of transit at least three times as rapid. The Dock Railway will then be available exclusively for goods.

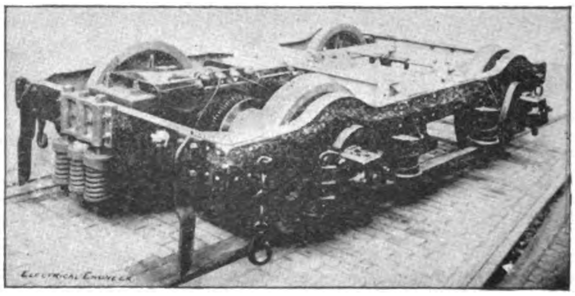
The overhead railway consists generally of plate iron girders supported upon channel iron columns and carrying an iron flooring upon which the permanent way is laid direct, without the usual intervening ballast. The normal spans are 50 feet, but there are some of 100 feet with bowstring girders and others of special construction for opening and affording a passage to the docks for exceptionally bulky goods, such as marine boilers, etc. Thus there is a tilting bridge near the Sandown Dock and a swing bridge of novel construction and worked hydraulically, crossing the entrance to the Stanley Dock. This is the only dock entrance crossed by the railway, the other docks being nearer the river.

The columns are grouted into cast iron sockets bedded in and bolted to masses of concrete forming the foundations. With the exception of some half dozen spans the line has been constructed without the use of scaffolding and with very little interference with the traffic, either of the docks or of the streets. This important end was attained by adopting a construction which admitted of each span and its flooring being put together at one end and transported as a whole over the already completed portion of the railway. A depot was established at the north end of the railway where the flooring was constructed and to the main girders put together. The whole span was then raised by jacks. A steam trolley with wheels running upon the two rails nearest the main girders (and thus having a gauge of 16 feet) was run under the span, which, being lowered upon the trolley, was carried by it at such a level as to clear the main girders to the southern end of the structure. Arrived at this point the span was slung upon a movable gantry and deposited by it upon the columns prepared to receive it. In this manner span after span was added, as many as 12 being placed in a week, representing a length of 600 feet of railway.



GENERATOR, LIVERPOOL ELEVATED ELECTRIC RAILWAY.

The decking is of arched plates, finishing to 2 feet 6 inches wide and 15 inches deep, made water tight by asphalt placed in the V channel between the arches. This form of flooring (known as Hobson's arch-plate system) first used on this railway, is being extensively used elsewhere. It is for its weight of great strength and stiffness and is readily made water-tight. The flooring is made of ordinary iron plates and tees. The plates are 46 inches wide by $\frac{5}{16}$ inch thick and vary in length from 22 to 27 feet. The tees are $4\frac{1}{2} \times 3\frac{1}{2} \times \frac{7}{16}$ inches section.



MOTOR TRUCK, LIVERPOOL ELEVATED ELECTRIC RAILWAY.

The construction of the decking is somewhat as follows: The flat plates are sheared to exact length and width. Six of them are heated at one time to a cherry red heat; they are then separately placed endwise in a hydraulic press which bends them to the required shape. After cooling upon a gird or frame where they are tightly held to prevent change of form, they are taken to a multiple drilling machine which drills the requisite rivet holes (about 200) in two operations and in 15 minutes. After the end angle irons for attachment to the main girders are added, the decking is completed by rivetting mechanically the curved plates to the T-irons forming the lower member. These combined operations are performed at the rate of 40 to 45 plates per day.

There are 15 stations on the line which are built on iron girders and columns, the platforms being about 150 feet in length by 12 feet wide and are three feet above the level of the rails. Access to the platforms is gained from the street level by four staircases at the more important stations and on each platform a waiting shed is provided with pay offices and turnstiles. An extensive carriage shed is erected near the Hornby Docks with five lines of rails running through at the same rail level as the main structure of the railway and on the ground floor is the repairing shop to be equipped with the necessary tools.

III.

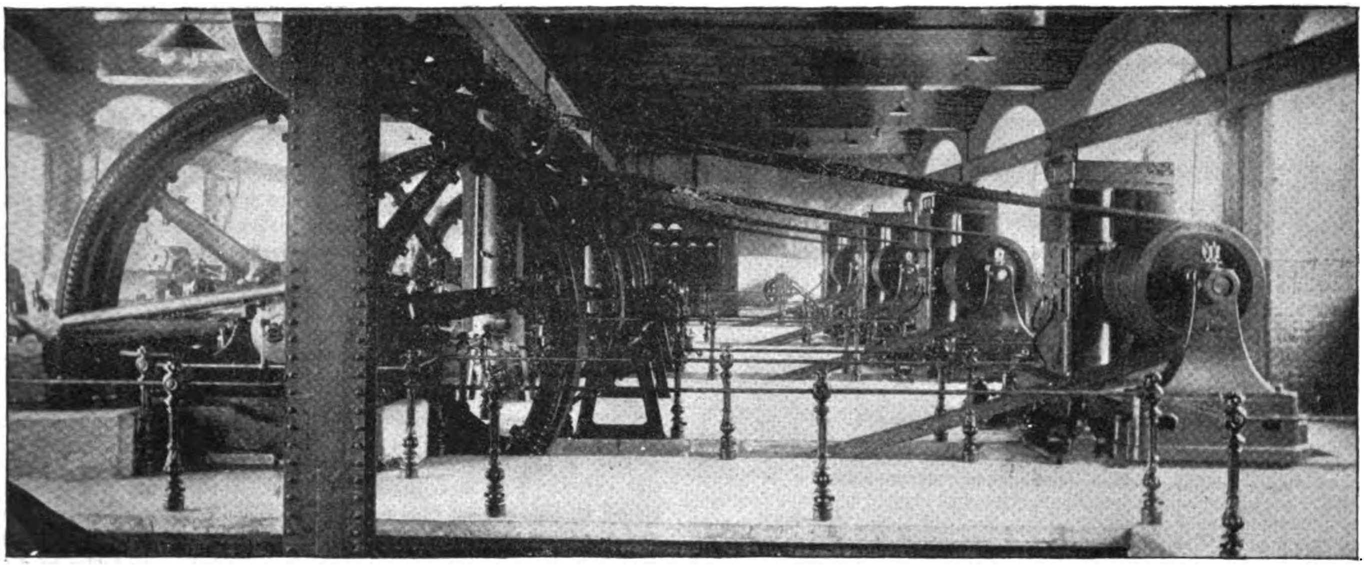
The permanent way is of a novel construction. Longitudinal sleepers resting directly upon and keyed to the arched decking support the rails and the electric conductor.

The conductor, consisting of a steel channel, is carried the whole length of both up and down lines between the ordinary rails, the latter forming the return circuit. The steel channel is carried upon porcelain insulators supported by cross timbers between the longitudinal sleepers. The surface of the steel channel, forming the centre conductor, is $\frac{7}{8}$ inch higher than the top of the ordinary rails. At the cross-over points the conductor is bent so as to run parallel for a short distance on each side of the ordinary rails, but leaving ample clearance to prevent arcing across.

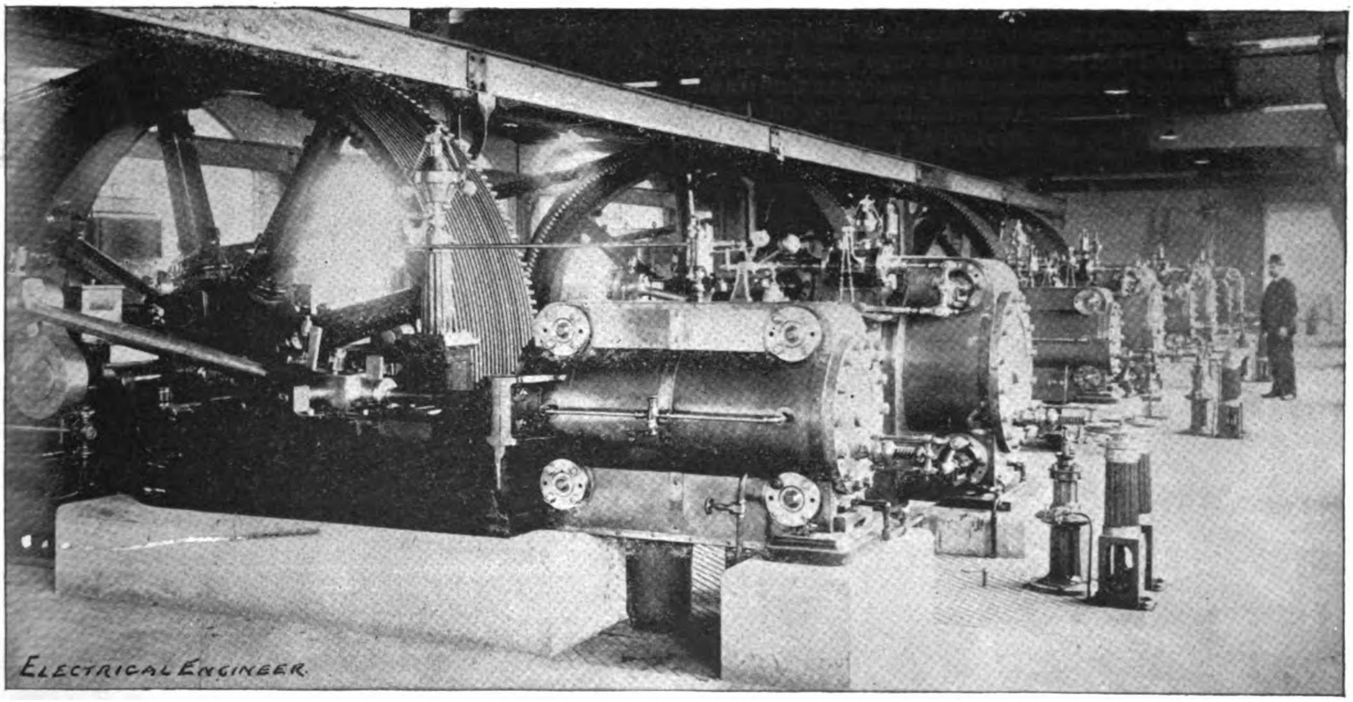
Timmis' automatic signals are to be used which will be operated electrically by the trains, thus doing away with signalmen.

IV.

The generating station occupies a position close to the structure and approximately in the centre of its length. In this are six Lancashire boilers, 30 feet by 8 feet, constructed for a working pressure of 120 lbs. per sq. inch, fired by Vicars' mechanical stokers, the coal supply being drawn from hoppers overhead into which the trucks on the existing coal railway are emptied. Coal is supplied to the various boilers by means of a conveyor. Green's fuel economizer consisting of 384 pipes is used.



DYNAMO ROOM, LIVERPOOL ELEVATED ELECTRIC RAILWAY.

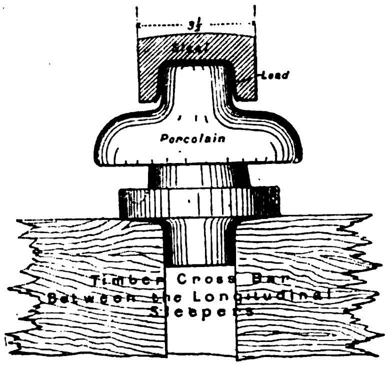


ENGINE ROOM, LIVERPOOL ELEVATED ELECTRIC RAILWAY.

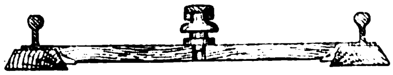
There are four horizontal, coupled compound engines, each capable of indicating 400 h. p. with 120 lbs. steam pressure at 100 revolutions per minute. The cylinders are 15½ inches and 31 inches diameter, by 36 inches stroke. Corliss valves are fitted to all the cylinders. The fly-wheels are 14 feet in diameter, grooved for 19 1½-inch diameter ropes.

An independent condensing arrangement is used, divided into two units, each capable of condensing steam from three of the main engines running under full load. The condensing water is taken from the dock adjoining the generating station and passes through brass tubes. The air and circulating (centrifugal) pumps are driven by small compound vertical engines having Ferguson's patent triangular connecting rods with cylinders 7½ inches by 15 inches diameter, 12 inch stroke. The auxiliary plant consists of two pumping engines for boiler feed, each capable of supplying four boilers; one engine for driving stoker and conveyor, 10 h. p., and two small engines for working the scrapers on the economizers.

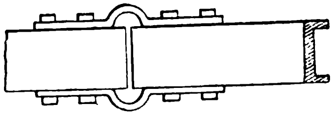
All the steam and feed pipes are arranged to give a duplicate service between the boilers, engines and pumps. Arrangements are also made so that the engines may exhaust into the atmosphere in case of water not being obtainable at any time for condensing.



Steel Conductor Bar and Insulator



Cross Timber Supporting Conductor

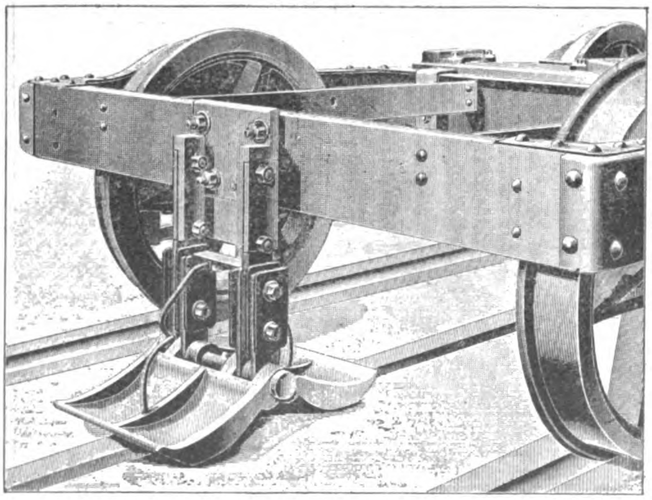


Copper Connections of Conductor Lengths

DETAILS OF STEEL CHANNEL CONDUCTOR AND INSULATOR.

V.

The dynamos are four Elwell-Parker shunt wound machines, each giving an output of 475 amperes at 500 volts at 409 revolutions per minute. The magnets are of the double horse-shoe type fixed vertically, divided on the horizontal centre line so that the top half can be readily lifted off to allow of examination or removal of the armature. A pulley is carried between two bearings which, when a coupling is inserted between the pulley and armature shafts allows the latter to be taken out without taking off ropes, dismounting the pulley, or interfering with the set of the bearings.



CURRENT COLLECTOR, ATTACHED TO MOTOR TRUCK.

Each dynamo is coupled up through an ammeter to a double-pole automatic magnetic cut-out, which also answers the purpose of a main switch. All the machines couple in parallel on to omnibus bars from which the current is taken by underground armored cables to the conductors on the line, a larger automatic magnetic cut-out being inserted, carrying the whole of the current. Multiple contact switches and resistance coils in the shunt circuit are employed for regulating the E. M. F. of the machines.

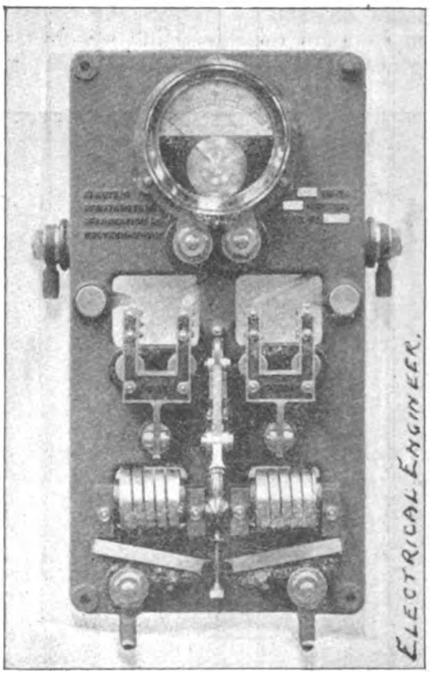
VI.

The length of the carriages over end pillars is 45 feet, the width over side pillars being 8 feet 6 inches. The carriages are mounted on two 4-wheeled bogies, 32 feet apart on centres, and one of which carries a motor. The wheel base of bogies is 7 feet, the wheels being 2 feet 9 inches diameter. They carry 57 passengers, 16 first class and 41 second class. Two carriages form a train and as each is fitted at one end with a driver's box and necessary switch and brake gear for controlling the work there is no shunting at the terminal stations, the driver changing ends. The gangway between the two cars gives a clear passage through for the guard. A train loaded with passengers will weigh about 40 tons. The motors on each train are on the leading and trailing bogies. Six incandescent lamps light each carriage, supplied with current from the centre conductor the same as the motors.

VII.

The armatures of the motors are mounted directly upon the axles. Ten revolutions of the axle per minute gives a speed to the car of one mile per hour. The maximum speed necessary to do the journey in the time specified is approximately 26 miles per hour, or 260 revolutions of the motor per minute.

The motors are series wound and when tested with a brake gave the following torque effects on the rim of the wheels (2 feet 9 inches diameter) with respective currents given below, when at rest :



AUTOMATIC MAGNETIC CUT-OUT.

30 amperes	......	170 lbs.
40 "	......	300 "
50 "	......	450 "
60 "	......	650 "
80 "	......	1,060 "

The current is collected from the surface of the steel channel by means of cast iron shoes loosely hinged to insulated iron strips carried by the bogies. The shoes are made much wider than the conductor so as to stretch across at the cross-over roads from the conductor on the one side to the conductor on the other side of the ordinary rails. A collector is fitted to each motor bogie.

The carriages are fitted with Westinghouse brakes worked by compressed air stored in receivers carried under the carriages, these being charged by an air compressing plant fixed at the terminal station at the north end of the line. Hand screw brakes are also provided.

VIII.

The journey from one end of the line to the other will be completed in 30 minutes which includes a ½ minute stop at all stations. The rolling stock in the first instance provides for a five minutes service, though ultimately trains will be dispatched every three minutes. The present generating plant will allow of this being done. There are fairly sharp curves on the lines, the maximum being 400 feet radius. The maximum grade for a short distance is 1 in 40. The total cost of the railway including equipment will be about £85,000 per mile.

The electrical work has been carried out by Mr. Thomas Parker for the Electrical Construction Corporation.

STREET RAILWAY FIGURES IN MASSACHUSETTS.

THE various street railways in Massachusetts have entirely eclipsed the steam roads in the passenger traffic, showing a most remarkable increase the past year. The report of the Railroad Commissioners of the State shows a total mileage of street roads of 814.36 miles, and of this over 60 per cent. is now equipped with electric power with prospects of a much larger percentage using this same means of propulsion. A total of 193,760,783 passengers was carried during 1892, which exceeded the passenger traffic on the steam roads by 82,845,329.

The Commissioners further state that so far, no legislation has been enacted which takes note of the change that the street railway has undergone, with the substitution of electric power, a transformation by which it bears a closer resemblance in essential respects to the steam railroad than to the horse railway. The electric roads at present so far as being regulated at all are regulated only by a code of laws which was framed in reference to the original system of horse transportation. The Commission urges the necessity of laws being enacted which shall put the electric roads on a similar footing with steam roads in regard to grade crossings and other matters for the public safety.

The total amount of property and assets of the companies is $39,448,838; surplus over all liabilities, $855,379. The total average cost for each mile of railway track is $47,356. Whole number of cars owned, 3,659; increase, 165; number of employes, 7,157; increase, 708; total number of passengers carried, 193,760,783; increase, 17,670,594: gross income for year, $9,817,537; increase, $916,413; gross expenses, $7.461,224; increase, $338,931; net income, $2,356,312; increase, $577,482; average sum received for the conveyance of a passenger, 5.07 cents; average cost of carrying a passenger, 3.85 cents; whole amount of dividends paid, $1,582,697, an average of 6 72 per cent. on the total amount of capital stock, as against 5.63 per cent. the previous year. Total number of accidents, 610, of which 26 were fatal.

PROPOSED CONNECTICUT STREET RAILWAY COMMISSION.

SENATOR Root has introduced an Electrical Street Railway bill in the Connecticut state senate, empowering the Governor to appoint a street railway commission, to consist of three members, whose terms shall be one, two and three years respectively from July 1, 1893. One member of the commission shall be a lawyer, another an electrical engineer, and the third a business man. The governor shall have power to designate the chairman of the commission, who shall receive a salary of $3,000 per annum. The other members shall have a salary of $2,500 yearly; and no member shall have any personal interest in any street railway, or in the manufacture of any electrical appliances or apparatus for the use of such railways. The expense of the commission shall be met by a tax laid upon the gross earnings of the electric railway companies of the state. Wherever an electric road shall already be in operation or existence, no other company shall interfere in any manner without first applying to the mayor, and board of aldermen and councilmen of cities and selectmen in towns, who shall call a hearing of parties interested. From the decision of these bodies any dissatisfied persons shall have the right of appeal to the street railroad commission, whose decision in the matter shall be final, and from which there shall be no appeal.

THE LAKE STREET ELECTRIC ROAD IN CHICAGO.

THE Directors have been given full power to close a contract with the construction company that is to build, equip, and open for traffic the entire seven and a half miles of road during the present year. The old company gave up its control, finally and completely, and dating from February 2, the Eastern capitalists, who own practically nine-tenths of the issued stock in the new company, will dominate affairs.

The stockholders further agreed to increase the capital stock of the company in the near future from $5,000,000 to $10,000,000. They also empowered the directors to issue $6,500,000 in first mortgage bonds, payable in gold and bearing five per cent. interest on the property, rights, and franchises of the company. This issue of bonds is intended to pay for the entire construction of the road, which will cost upward of $5,000,000 with equipment, to pay off all outstanding obligations, including the bonds issued by the old company, and to leave a surplus in the treasury for current expenses. After the adoption of these resolutions the stockholders adjourned *sine die*. The directors met immediately and voted to issue the $6,500,000 in bonds as provided by the stockholders.

ELECTRIC RAILWAY FINANCING IN RHODE ISLAND.

THE entire surface-car system of Providence has been sold by the Union Railroad Company. This includes every cable, electric and horse car line in the city, an exclusive franchise of every street in Providence for twenty-five years, and the right to equip every line with electricity. The reported price paid for the control is $5,000,000, and the consummation of the deal created something akin to a sensation in financial circles. The officers of the company refuse to give the names of the syndicate which has purchased a controlling interest of the stock, but it is declared by persons in authority to be the Metropolitan Traction Company of New York and the Thomson-Houston Electric Company.

A syndicate is also attempting to purchase the franchises of the Pawtucket Valley Electric Railroad, which has the right to operate all through the central and southern parts of the state. A Philadelphia syndicate has also made a big offer for the entire plant of the Inter-State Street Railway Company, which connects Northern Rhode Island and Southern Massachusetts.

A "STRIKE" AT ELECTRIC ROADS.

THE following bill has been introduced in the New York legislature: Section 1. On and after the passage of this act the use of electric wires or contrivances above ground for the operation of street cars in the cities of this State shall be unlawful. 2. Immediately on the passage of this act, it shall be the duty of the Electric Subway Commissions in cities where such bodies exist, and elsewhere of the Commissioner of Public Works to direct the placing underground of all electric wires and contrivances in use in the operation of street cars, so that the work can be completed on or before December 31, 1893.

SOCIETY AND CLUB NOTES.

FRANKLIN ELECTRICAL SOCIETY LECTURES.

A COURSE of lectures under the auspices of the Franklin Electrical Society will be given at the Evening Trade School, 225 and 227 East Ninth street on the five consecutive Saturdays from February 11 to March 18 inclusive, commencing at eight o'clock in the evening. The subjects will be; Feb. 11, Electrical Transmission of Energy, by Newton Harrison; Feb. 18, The Earth in Past Ages, by E. S. Barney; Feb. 25, Chemistry and its Relation to Electricity, by J. A. Moses; March 11, Development of the Electric Arc Lamp, by E. V. Lallier; March 18, Dynamo Electric Machinery, by W. Wallace Ker.

Tickets may be had from Mr. A. A. Hammershlag, the secretary, at room 301, Electrical Exchange Building, 136 Liberty street.

THE MONTREAL ELECTRIC CLUB.

THIS club has been recently organized among the practical electricians of Montreal for the discussion of electrical topics and the mutual advancement of its members in the knowledge of electrical science. Suitable quarters have been secured on Phillips' Square, where meetings will be held every two weeks. The following are the officers of the club: Mr. W. B. Shaw, president; Mr. J. A. Farlinger, vice-president; and Mr. J. Burnett, secretary-treasurer. Mr. H. Woodman read an instructive paper on "Outside Construction" at a meeting held on Feb. 6th. At the previous meeting an interesting paper was read by Mr. James Burnett treating the different methods of connecting the armature and field windings of dynamos and motors.

PERSONAL.

MR. J. POTTER.

Mr. J. Potter, who has been for many years treasurer of the Brush Electric Company and is president of the Short Electric Railway Company, Cleveland, has resigned these offices to take effect at the convenience of the companies. Mr. Potter graduated from Princeton College in 1877. For several years he was master in the Lawrenceville school, during which time he read law. In 1881 he decided to engage in the electrical industries, and made an engagement with the Brush Electric Company to take charge of its business in China and Japan, and was a pioneer of electric lighting in those countries. He resided for a number of years in Yokohama, and made large contracts for Brush apparatus with the Chinese and Japanese governments, and established the first electric lighting stations in the Orient. In 1884 he returned to Cleveland to take the positions of a director and treasurer of the Brush Company. It is understood that Mr. Potter will devote himself entirely to his private business interests. He is one of the promoters of the projected Lake Street and Crosstown railway in Cleveland. He is also interested in a number of electric railway enterprises, to which he will also give attention.

MR. ANGUS S. HIBBARD.

After seven years of most successful work as general superintendent of the American Telegraph and Telephone Company (Long Distance Company) Mr. Angus S. Hibbard has resigned his position in order to assume the general managership of the Chicago Telephone Company. Viewing the work accomplished by Mr. Hibbard, the Chicago Telephone Company is to be congratulated upon securing the services of so able an officer, whose work will no doubt soon become apparent. Mr. Hibbard will be aided in his work by Mr. W. T. C. Baldwin, who has resigned from the electrical staff of the Metropolitan Telegraph and Telephone Company, of New York, and assumed the position of superintendent of the Chicago Telephone Company.

MR. DAVID E. EVANS.

It will be gratifying to the many friends of Mr. David E. Evans, of the firm of D. E. Evans & Co., of Baltimore, to learn that he has been appointed consulting engineer for the Petersburg, Va., municipal electric lighting plant, having been selected for the position from among 165 applicants.

Mr. Evans went to Baltimore in 1880 and built the first electric light station in the world, that is to say, the first station that was designed from the ground up for the purpose of electrical distribution. Mr. Evans' experience in central station as well as in isolated plant work places him among the most prominent and successful electrical engineers in this country.

Mr. B. F. Meek, Jr., for several years the secretary of the Northwest General Electric Company, has been promoted to the vice-presidency of that company. Mr. Meek has been connected with the company since its organization in 1888, surviving all the many changes that have taken place in its ranks since that time.

Mr. W. A. Kreidler, the publisher and principal owner of the *Western Electrician*, was married last week to Miss Netta O. Preston, and after the ceremony at Elgin, Ill., left for an extended wedding trip through Florida.

LITERATURE.

Text-Book of Experimental Engineering. By Rolla C. Carpenter, M. S., C. E. & M. M. M. *New York,* John Wiley & Sons, 1892. 709 pp. 6 by 9¼. Price $6.00.

The testing of machines and materials and prime movers has now become so important a branch of the engineer's work, that a course of work of this nature is deservedly given prominence in our best schools at the present day.

The author has in the present volume gathered a most valuable series of data and methods which are intended as a text-book of experimental engineering to guide the student in his work.

The work before us first brings before the student the methods of reducing experimental data, then the apparatus by which the measurements are made, pointing out their errors and methods of employment. From these the author passes on to the general formula of the strength of materials and the description of various testing machines. In this way he successively treats of the testing for friction and of lubricants, the measurement of liquids and gases, and of the principal prime movers. The steam engine and steam in general are given special prominence, but we note an entire absence of all mention of the dynamo and electric motor. Such an omission might have been condoned 10 years ago, but now it cannot be forgiven. The present importance of these machines, ought, we think, to have secured for them at least some mention in the present work. With this exception the book can be heartily recommended as a text-book and guide in laboratory work. The engravings throughout are clear, and the book is got up in excellent style.

Minutes of the Proceedings of the Engineering Association of New South Wales. Vol. 7. *Sydney, N. S. W.* Published by the Association, 1892.

Annuaire du Bureau des Longitudes. Paris, Gauthiers-Villars & Fils, 1893. Price 60 cents.

LETTERS TO THE EDITOR.

THE ACTION OF THE TESLA MOTOR.

I have just seen a work on "Continental Systems of Electric Lighting," by Hedges, and was surprised to find in it a statement to the effect that the Tesla two-phase motor was inferior to the three-phase motor, in the fact that it would not start itself but had to be brought up to synchronism with the generator before it would run as an alternating current motor. This statement, however, is so evidently a mistake that I would not have called attention to it if I had not found on the same page a statement which seems to have received quite general credence, namely, that "the rotating field produced by the two-phase current consists of a pair of rotating poles that fluctuate in intensity, while that produced by the three-phase current, although it fluctuates to some extent, gives a good deal less variation."

I do not know who is responsible for this statement originally, but it is certainly a mistake, as a moment's thought will show. I call attention to it because I have heard it spoken of by so many different persons that it seems to me to have been pretty generally accepted as a fact. It should be remembered that the two currents in a two-phase motor act upon poles that are at right angles to each other, and the case therefore is one of a combination of two vibrations in planes at right angles with each other and differing by a quarter phase. The old experiments of Lissajous, familiar to every student, show that two such vibrations of the same amplitude and represented by the sine curve, when compounded give a perfect circle, and, in the Tesla motor with the alternating currents varying as the curve of sines, the rotating field may be perfectly constant and produce a perfectly constant pull upon the armature throughout the entire revolution. The difficulty is that in studying the action of these two-phase currents it has been assumed that they are currents represented by vibrations in the same plane, and differing by a quarter phase.

Wm. A. Anthony.

Manchester, Conn., Feb. 8, 1893.

COMPOUND GENERATORS WITH VARIABLE SERIES SHUNT.

The question of the utility of the series coil shunt being still under discussion, I would like to say that I have found a variable shunt, a valuable adjunct to a compound wound dynamo. For, when a generator is over-compounded, by an amount which is countered by a variable resistance in shunt to the series coil, one may change the over-compounding at will, more especially to correct the variations in speed. A builder or designer does not know the range of variations, in speed, his machine may encounter after it leaves the factory, and for that reason I think a variable shunt should be placed on every compound-wound dynamo.

I have adjusted the shunt coils on two dynamos so that the hand regulators did not have to be moved for changes from 100 lights to 3,000 lights. This could not have been done without the variable shunt, unless the maker had a chance to practice with this particular speed in this plant, and then made a fixed shunt to fit it.

L. M. Sheldon.

Boston, Mass. Feb., 7, 1893.

WHEN NATURE LETS LOOSE.

The following is a fair example of what the average lay reporter can do when he essays to write up electrical subjects, and of such is the authority of the sensational press for its strictures on the "deadly current."

The article was published in the New York *Evening Sun* of Jan. 21, and credited to the *St. Louis Republic*:—

Horse Power of a Thunderbolt.

Those who are unacquainted with the facts in the case often express surprise when told that not more than one man in 500 who has been struck by lightning survives, and that with the larger animals the ratio is still smaller. In this age

> of investigation, electric and otherwise, the layman can give explanations for natural phenomena that would have staggered the so-called philosophers of olden times. Thus we find that the E. M. F. of lightning has been a subject of discussion for some time past, amateurs and experts alike taking part in the argument.
>
> At Berlin the great Academy of Sciences grappled with the subject, and the spirited discussions over the "dynamic force of the unseen bolt" were only second to the question: "How shall we kill the comma bacilli?" Making contentions from all those wrangles and deductions, I find that the generally accepted opinion is that the E. M. F. of a bolt of lightning is about 3,500,000 volts, the current about 14,000,000 amperes, and the time of the discharge about 1-20,000 part of a second. In such a "bolt" there is an energy equal to 2,450,000,000 watts, or about 3,284,182 h. p.! Is it any wonder that "lightning usually kills?"

This is not only wrong as to data, but is woefully inaccurate in arithmetic; the energy of a current of 14,000,000 amperes at 3,500,000 volts would be 49,000,000,000,000 watts (watts = amperes × volts) instead of 2,450,000,000, and the horse power $\left(\frac{W}{746}\right)$ would be 65,683,646,118 instead of 3,284,182, as stated in the above article.

Then again the resistance of the air appears to be only .25 ohm $\left(R = \frac{E}{C}\right)$; under such circumstances the transmission of power at 10,000 volts over exposed conductors would be a highly impracticable undertaking.

We advise our friend to avoid exposure during thunderstorms, lest Jove smite him and thereby relieve the fool killer of a duty.

New York, Jan. 23, 1893.

* * *

A CASE OF TEMPORARY ABERRATION.

Did the editor or publisher of *The Electrical World* manufacture his little list of first page paragraphs in the issue of Feb. 4, under the stress of an enlarged cranium too tightly incased in his ordinary hat? Hear him think aloud:—

> **Proper Use of Terms.** We often notice, especially in papers written by mechanical, civil and other engineers who are not electricians, that they use electrical terms incorrectly. We refer at present more particular to the loose way in which the terms kilowatt and kilowatt-hour are used. A kilowatt is a unit of power or activity, and includes the element of time. On the other hand a kilowatt-hour is a unit of work or energy, and is as a unit entirely independent of the element of time; it is precisely like the terms foot-pounds, or horse-power-hour, or joule, into which it is directly convertible.

Could a man get mixed up much worse?

Can anybody conceive of how a volt-ampere, or any number of volt-amperes, can "include the element of time?" May not a watt be as truly a watt if expended only for $\frac{1}{1000000}$ of a second as if such a rate of expenditure were kept up for a year?

Can the said editor, during the lucid intervals when his hat fits him, reflect that "a kilowatt-hour" is as a unit entirely independent of time, when time is one of its factors?

Is it really "precisely like the term foot-pounds," which does not include time (but which may mean a very rapid or a very slow expenditure of energy, according as it is coupled with a rate), and *also* precisely like "horse-power-hour" which always indicates work done at a definite rate per second and also for a definite total period?

Let our friend the editor remember that every tyro in electrical study should understand that as long as volts represent difference of potential, and amperes represent simply and only the number of volts expended in each ohm of the resistance, the product of this total potential difference multiplied by this rate of potential expenditure for each ohm (not a rate as referring to time) will give the watts, which are still watts no matter how minute or how vast the period during which this degree of activity continues. Hence a watt or a kilowatt has nothing to do with time, and the *World* should be careful lest its honored editor places himself in the category of those whom he characterizes as "mechanical, civil and other engineers who are not electricians," —who, by the way, sometimes do write papers which electricians do well to study with care.

W. J. Jenks.

New York City, February 9, 1893.

ELECTRICAL TRANSMISSION IN ITALY.

In Italy, where there are numerous small water powers, the Italian Electrical Society is making many applications of electric transmission. From the Gravellone waterfall near Padua, 200 h. p. are carried half a mile; the Alzano waterfall is used to distribute 180 h. p. at one-third of a mile, 40 h. p. at half a mile, and 50 h. p. at three miles. A plant is now under construction to transmit 1,000 H.P. from the Cassagno falls to Intra, a distance of six miles.

LIGHTING UP THE ATLANTIC.

The Compagnie Transatlantique has again brought forward the question of lighting the Atlantic route, from Ireland to Newfoundland. It is proposed to put ten powerful floating lights 200 miles apart, and connect them by electric cables.

MISCELLANEOUS.

THE K-R LAW IN TELEPHONY.[1]

BY W. H. PREECE, F. R. S.

The institution of telephone exchanges has led to a development of systems of switching that might fairly be considered a special study in themselves, and the demand for communication between distant places has necessitated the application of much special attention to the method of constructing lines and of arranging circuits.

It is in this latter field that I have been a diligent worker, and the application of the so-called "*K R*" law has proved of material benefit in connection with the problems of long-distance telephony. It is a law which implies that the number of signals that can be transmitted per second through any circuit depends solely on the capacity (*K*) and the resistance (*R*) of the circuit. It is very much the fashion to deny the accuracy of the *K R* law. This is probably the result of ignorance of its meaning or of its interpretation. Some speak of it as empirical, others scoff at it as imaginary, and some sneer at it as an impossible law; but it is a law that has determined the dimensions and speed of working of all our long submarine cables; it determines the number of arms a circuit can carry on the multiplex system, the speed attainable with the Wheatstone system, and the distance to which it is possible to work quadruplex; it is a law that has enabled us to bring London and Paris within clear telephone speech of each other, and which will probably before the year is out enable Dublin and Belfast to speak to London—a message of peace to Ireland as solid and substantial as any promised political proposal.

The New York and Chicago trunk line is 950 miles long, and it is built with 435 lb. (or No. 8 S. W. G.) copper wire. This wire gives a resistance of 2.06 ohms per mile, which is easily verified; but it is said by Mr. Wetzler[2] to have a capacity of 0.0158 microfarad per mile, which cannot be verified, and which is absurdly high. 0.0158 microfarad was a measurement made by me in England on an old line, but I have frequently pointed out that owing to the use of earth wires the capacity of our English lines is very much greater than that of American lines. Mr. Edison discovered this in 1872 when he came to England to introduce his automatic system. Moreover, I have also pointed out that induction still further diminishes this capacity. The Paris circuit does not exceed 0.005 microfarad per mile. I should estimate the Chicago circuit at 0.004 microfarad per mile, and K R at 7,500, which gives a result that quite accords with the opinions that I have heard expressed by those who have tried the two circuits as to the relative efficiency of the Paris and Chicago lines. My American friends would have done better if they had used thicker wire. I should have specified 600 lbs. per mile; but if it had been in England I should have used 1,000 lbs., for we cannot dispense entirely with cables and underground work as they have done in the States, and the increased capacity introduced must be compensated for by reduced resistance. As a matter of fact, I once proposed 1,200 lbs. wire for a circuit between London and Berlin—a distance of 760 miles, including a cable 55 miles long.

The beneficial effect of induction as a negative capacity is observed when working a circuit telegraphically with automatic high-speed apparatus. Thus, on two copper wires 450 miles long, making 900 miles altogether, the speed on each single wire was 120 words per minute, and on metallic circuit—

Loop *via* different routes..... 120 words per minute.
" on same poles.......... 150 " "

So that the improvement effected by induction was 25 per cent.

There is no difficulty in measuring *R* of a metallic loop. The Wheatstone bridge determines it at once. There is more difficulty in obtaining *K*. It cannot be measured directly. But with a metallic loop of copper, partly overhead and partly underground, there are several modifications required, due to electrostatic and electromagnetic induction, which are at present beyond the reach of formulæ, and render it difficult to determine the capacity except approximately from the telephonic effects themselves. Thus the capacity on the London-Paris circuit proved to be only one-half of that obtained by calculation, and every long circuit will require its own *K* to be determined by comparison with an empirical *K R* scale. Such a scale I have determined by careful experiment on artificial cables.

I have recently devised a new form of cable which will probably quadruple the rate of telegraph working to America; and I may say with all confidence that there is no theoretical reason whatever why we should not converse between London and every capital in Europe, while it is not impossible to speak even across the Atlantic.

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[1] Abstract from Presidential Inaugural Address delivered before the London Institution of Electrical Engineers, Jan. 26, 1893.

[2] See The Electrical Engineer, Dec. 14, 1892: "The Engineering Details of the New York-Chicago Long Distance Telephone Line," by Joseph Wetzler.

OPENING OF THE LONG DISTANCE TELEPHONE SERVICE BETWEEN BOSTON AND CHICAGO.

THE handsome offices of the American Telephone and Telegraph Company, at 125 Milk street, Boston, were crowded on Tuesday evening, the 7th inst., by about 400 of Boston's most influential citizens to witness the opening ceremony of the long distance service between Boston and Chicago. The room is a large one on the ground floor and was handsomely decorated for the occasion. In the centre of the room was situated one of the usual long distance desks, with transmitter and receiver as shown in our engraving, and immediately adjoining was a table covered with yellow silk, upon which rested about forty ordinary hand telephones or receivers. Overhead attached to the electrolier and covered from view by means of festoons of evergreens, were two other receivers attached to which were bell-shaped horns, for the purpose of emitting the musical strains which came all the way from Chicago. Shortly after four o'clock Governor Russell appeared on the scene, and as if inspired by magic the musical horns began to breathe forth the inspiring strains of "Hail to the Chief." The music was rendered perfectly and could be heard most distinctly all over the room, although transmitted some 1,200 miles. The Governor then took his position at the instrument, with Lieutenant-Governor Wolcott directly behind him, and Adjutant General Dalton on his left hand, easily recognizable as the only gentleman present in uniform. Governor Russell, after being photographed at the desk, called up Chicago and spoke for a few minutes with Mr. Wendell Baker, the special agent for the American Telegraph and Telephone Company in Chicago, stating that he congratulated the company upon the extension of the long distance lines from Chicago to the State of Massachusetts, and that he looked upon the enterprise as a most important commercial event. He regarded the completion of this work as one of many ties that would bind us closer together as a nation. The conversation was distinctly heard in Chicago, and Mr. Baker's replies were most distinctly heard by the Governor and forty of the guests fortunate enough to have secured the spare receivers. After the ceremony, while numbers stayed to talk further with Chicago, others went to the top of the building and inspected the magnificent switchboards of the local telephone company and the Long Distance company, after which all adjourned to a room on the second floor of the building, where a most substantial collation was laid out. It was enjoyed to the accompaniment of music by the Germania Orchestra. The entertainment lasted from four until seven and it was the universal opinion that the Long Distance Company had provided an entertainment unique in character, and most interesting and enjoyable in all its details.

A. C. S.

ELECTRICAL ENGINEER.

NEW ENGLAND INTERVIEWING THE WEST BY TELEPHONE.

WORK OF THE CHICAGO CITY ELECTRICAL INSPECTION DEPARTMENT.

WE are in receipt of the following statement of the work done by the City Electrical Inspection Department during the year 1892, just issued by Prof. J. P. Barrett, superintendent. The statement also includes the yearly inspection of electric lamps in the city from Feb. 14, 1884 to Jan. 1, 1893.

LAMPS INSPECTED.

ARC.		INCANDESCENT.	
1892	5,046	1892	101,668
Previous years	14,441	Previous years	190,282
Total	19,487	Total	291,950

MOTORS INSPECTED.

		INSTALLATIONS "WIRED ONLY."	
1892	504	1892	188
Previous years	668	Generators	345
Total	1,172		

REINSPECTED.

ARC LAMPS.		INCANDESCENT LAMPS.	
1892	2,082	1892	30,998

STATEMENT OF YEARLY INSPECTION OF ELECTRIC LAMPS FROM FEB. 14TH, 1884 TO JAN. 1ST, 1893.

YEAR.	NO. OF ARC.	NO. OF INCAN.	TOTAL WIRING. MILES.	FEET.
1884	1,148	1,885		
1885	829	7,609		
1886	479	5,225		
1887	887	5,424		
1888	2,369	17,712		
1889	2,628	24,966		
1890	2,682	39,548		
1891	3,974	87,918		
1892	5,046	101,668	1,001	1,828
Total	19,487	291,950	1,001	1,828

ELECTRO-HYPNOTISM IN CONGRESS.

THERE are some curious bills before Congress. Senator Mitchell has introduced one, "by request," which is to prohibit electro-magnetizing, mesmerizing, or hypnotizing human beings, or affecting one person through another with electricity. The petition accompanying the bill speaks of the systems "which prevail among magnetizers and theosophical sections [*sic!*] of transferring the magnetism of others, thus weakening the understanding and disturbing the concentration of thought by depleting the brain." The gravity of these facts has so impressed the originator of the bill that he proposes neither more nor less than that electro-magnetizers, mesmerizers, hypnotizers, and electric fiends convicted of practising their dangerous arts within the District of Columbia, or the territory or waters within the jurisdiction of the United States, shall be punished with death, while those who, knowing of such practices, fail to give information to the rightful authorities, shall be imprisoned (for life, if deemed advisable) and made to pay a fine of not less than $5,000 besides.

THE TARIFF AND ELECTRIC RAILWAY MATERIAL.

A DISPATCH from Washington of February 7th says: "When the Senate a few days ago referred to the Finance Committee the bill which had been favorably reported by the Commerce Committee permitting the St. Louis & Chicago Electric Railroad Company to import free of duty machinery necessary for the construction of the road, the Republican protectionists in the Senate thought that the bill had been pigeon-holed for the session. However, the Finance Committee this morning disappointed these expectations and resolved to report the bill back to the Senate with the recommendation that it pass, and, of course, this was achieved by the aid of Republican votes in the committee. So the bill enjoys the distinction of being the first and probably the only bill touching the tariff which the Finance Committee has reported or will report to the Senate this Congress."

NEW COMPETITION TELEPHONE COMPANIES.

It is rumored that the old Meucci Telephone Company, of which James R. English, of Elizabeth, N. J., is president, is about, it is alleged, to revive its charter and begin active operations in Elizabeth and other cities of New Jersey.

The Meucci Company once had a regular system in operation in Elizabeth, but had to discontinue business on account of infringing the Bell Company's patents now expiring. Report has it that capitalists of Elizabeth, Newark, Plainfield, and some other cities are about to organize a strong company to build both trunk and local lines to operate throughout the State, and to control the Meucci franchise and the poles and wires of the New Jersey Postal Telegraph Company, which has a system now doing a general telegraph business between New York and Asbury Park and touching at all intermediate cities and towns. It is said that a large factory is now in course of construction at Red Bank for the exclusive manufacture of telephones to be sold outright for general use and that it has already filed orders ahead for several months.

It is also rumored that some of the capitalists in the Standard Oil Company will also be competitors and will engage actively in the business of making telephones.

A new telephone company, with a capital stock of $80,000,000, has applied for incorporation at the office of the Illinois Secretary of State. The name chosen is the Harrison International Telephone Company, and two conspicuous members of the Directory are Major William Warner and Richard C. Kierens. Mr. Warner is the ex-Commander in Chief of the Grand Army of the Republic, and Mr. Kierens is a well-known railway magnate and Missouri's member of the Republican National Committee.

The other directors are Dr. E. M. Harrison, of Forth Smith, the inventor of the telephone; L. E. Ingalls, of Chicago; George R. Peck, of Topeka, Kan.; Charles M. Feree, Albert L. Stone, John T. Blake, Howard M. Holden and Webster E. Davis, of Kansas City, and D. J. Young.

Charles M. Feree is president of the company, Howard M. Holden vice-president, Albert L. Stone secretary, and a prominent Chicago man, name withheld, is treasurer. A number of the directors are in Chicago and have been quietly holding meetings at the Grand Pacific Hotel.

The incorporators say that they can give service for one-half the rates now charged. President Feree said: "We will construct a circuit between New York, Boston, Buffalo, Cleveland, Detroit, St. Louis, Louisville, Cincinnati, Pittsburgh, Philadelphia, Washington, Baltimore, and from there back to New York.

"This circuit will cost $10,000,000, but we expect it to yield handsome dividends. One of the most important features of our new system is that we expect to do away entirely with the telephone girl. We do this by a system of automatic switchboards. In conjunction with the telephone we will have a new system of telegraphy by which messages are written out and an exact facsimile is transmitted to the receiver."

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JANUARY 31, 1893.

Accumulators:—

Secondary Battery Electrode, H. G. Osburn, Chicago, Ill., 490,758. Filed No. 21, 1891.

A plate having a multiplicity of bars deflected in opposite directions and forming receptacles for active material, and a re-inforcing conductor extending through the receptacles.

Alarms and Signals:—

Electric Block Signal System, J. La Burt, New York, 490,663. Filed Dec. 14, 1891.

A automatic electric block system for steam railways.

Automatic Alarm Device, G. W. Schilling and J. G. Haslam, Philadelphia, Pa., 490,684. Filed June 18, 1892.

An electric alarm for pipes supplying automatic sprinklers.

Electrical Time Indicating Apparatus, E. Weston, Newark, N. J., 490,698. Filed June 16, 1891.

Electric Burglar Alarm, W. H. Carr, Bath, Me., 490,870. Filed Sept. 22, 1892.

Electric Signaling System, A. J. Wilson and W. W. Salmon, Chicago, Port Chester, N. Y., 490,761. Filed Sept. 14, 1892.

An automatic block system for steam railways.

Conductors, Conduits and Insulators:—

Insulating Compound, M. H. Devey, Chester, Pa, 490,641. Filed Jan. 30, 1892.

A composition of powered slag, glass, boiled linseed oil, driers, shellac and paraffine.

Connector for Electrical Conductors, G. L. Russell, Middletown, Conn., 490,755. Filed Aug. 12, 1892.

Consist of a plate having a sharp edge, a clamping piece having a hook acting with the edge, and means for adjustably fastening the two parts together.

Dynamos and Motors:—

Dynamo Electric Machine or Electric Motor, R. Lundell, Brooklyn, N. Y., 490,810. Filed April 22, 1892.

Employs two hollow disc shaped field magnet coils each wholly enclosing a single field magnet coil, the latter being placed on opposite sides of the armature and in a plane parallel therewith.

Dynamo Electric Machine, R. Lundell, Brooklyn, N. Y., 490,809. Filed April 22, 1892.

Employs a disc armature and a single field magnet coil lying in a plane on one side of the armature and parallel with it, in combination with radially disposed multipolar pole pieces between which the armature rotates.

Heating:—

Electric Warming Bottle, T. Ahearn, Ottawa, Can., 490,891. Filed Sept. 8, 1892.

Lamps and Appurtenances:—

Manufacture of Carbon Filaments for Electric Lamps, T. A. Edison, Llewellyn Park, N. J., 490,954. Filed Nov. 6, 1886.

Consists in first forming filaments of carbonizable material, partially carbonizing them and afterward soaking them in a solution of a carbonizing substance and finally completely carbonizing them all.

Combined Gas and Electric Light Fixture, F. X. Gartland, Philadelphia, Pa., 490,908. Filed Jan. 23, 1892.

Electric Arc Lamp, J. Sugden & W. J. L. Sandy, London, England, 490,998. Filed July 13, 1892.

Relates to automatic mechanism for feeding the carbons of arc lamps.

Measurement:—

Recording Ammeter, E. Weston, Newark, N. J., 490,699. Filed March 18, 1892.

A recording ammeter having an arm actuated by a coil in the field of force and carrying a tracing device; and a moving record surface upon which the latter makes its record.

Electrical Measuring Instrument, E. Weston, Newark, N. J., 490,700. Filed March 29, 1892.

Employs a metal filament, an index controlled by the elongation and contraction of the former, and a support for the filament made of an alloy whose coefficient of expansion is the same as that of the filament.

Telethermometer, H. B. Payne, Chicago, Ill., 490,883. Filed Sept. 22, 1892.

Telethermometer, H. B. Payne, Chicago, Ill., 490,883. Filed May 20, 1892

Electrical Measuring Instrument, E. Weston, Newark, N. J., 490,760. Filed Oct. 3, 1892.

Employs two stationary coils side by side, a shaft extending diametrically through both coils, two other coils wound in opposite directions supported upon the shaft and disposed between the fixed coils, and a spring connected with the shaft and also with an abutment for the purpose of opposing the shaft's vibration.

Miscellaneous:—

Apparatus for Electrically Treating The Eyes, W. A. Price, Iowa Falls, Iowa, 490,678. Filed Sept. 24, 1892.

Apparatus for Electrically Treating The Ear, W. A. Price, Iowa Falls, Iowa, 470,679. Filed Sept. 29, 1892

Electrical Pressure Indicator for Steam Gauges, E. G. Smith, San Jose, Cal., 490,725. Filed July 6, 1892.

Electric Time System, W. F. Gardner, Washington, D. C., 490,744. Filed Sept. 4, 1891.

Art of Generating Electricity, T. A. Edison, Menlo Park, N. J. 490,953. Filed Nov. 1, 1883.

Consists of subjecting carbon to heat in an exhausting chamber and in the presence of an agent which combines with it.

Electric Belt, J. W. Cummings, Gold Hill, Nev., 490,948. Filed July 27, 1892.

Railways and Appliances:—

Electric Railway, E. W. Mitchell, Covington, Ky., 490,975. Filed June 23, 1892.

Employs a feed wire within an insulating covering having openings at intervals, a sectional service conductor extending along the line of the feed wire and having contacts which make connection with the latter when the car is passing.

Trolley Wheel, J. J. Goetz, Covington, and J. A. Smith, Dayton, Ky., 490,014. Filed May 20, 1892.

Switches and Cut-Outs:—

Electric Switch, J. S. Gibbs, Hartford, Conn., 490,746. Filed Nov. 1, 1892.

Consists of a base supporting double revolving poles and a key connected with both so that they act in unison.

Switch and Safety Fuse, E. P. Morris, Boston, Mass., 490,917. Filed Feb. 11, 1892.

Consists of a box containing the switch having a spindle projecting through the cover and having contact plates to which the fuse is secured, contacts in the box connected to the line and to the switch and engaging the contacts on the cover.

Electric Circuit Breaker, E. M. Bentley, Boston, Mass., 490,762. Filed Nov. 19, 1892.

Employs a travelling arm as one member, with a compressor moving with the arm and automatically delivering air across the arcing space at the instant of the breaking of the circuit.

SUGGESTIONS FROM THE COMMISSIONER OF PATENTS.

The Commissioner of Patents, in his annual report to Congress, shows that there has been a great improvement in the Patent Office under the workings of the classified service rules, and says that the appointment of commissioner and assistant commissioner should cease to be political, their salaries should be increased, and they should hold their offices on the tenure of good behavior.

Regarding the Patent Office exhibit at the World's Columbian Exposition, the report says that it will comprise upward of 2,500 models, nearly all of them working machines arranged in chronological order beginning with the first crude implement and ending with the latest improvements.

The report recommends legislation concerning international patent matters, says that our patent law is exceptionally liberal toward foreigners, and urges that legislation be enacted that will place American inventors on the same footing in foreign countries.

A number of amendments to the patent and trade-mark laws are embodied in the report. They are to the effect that no improvement shall be patentable which has been for more than two years before application for patent thereon disclosed in any patent or printed publication issued in this country; that a patent shall not expire with the expiration of a prior foreign patent for the same invention; that an applicant be compelled to take action upon his application at least once every six months; that a patent shall in no case live for more than twenty years from the date of first application therefor; that aliens be put upon the same footing as citizens as to the filing of caveats; that interference contests be abolished in the Patent Office and be relegated to the courts.

LEGAL NOTES.

INCANDESCENT LAMP LITIGATION.

EDISON ELECTRIC LIGHT COMPANY ET AL. (GENERAL ELECTRIC COMPANY) VS. WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY.

DOES THE NEW WESTINGHOUSE LAMP INFRINGE THE EDISON PATENT?

AT Pittsburgh, on Thursday, February 9, argument was heard in the United States Circuit Court for the Western District of Pennsylvania, by Judges Buffington and Acheson, upon a motion by the complainants to dismiss the motion of the Westinghouse Company for an order of the Court upon the complainants to show cause why the Edison Company should not be restrained from interfering with the defendants in the manufacture and sale of the new Westinghouse lamp. As is now well known, the Westinghouse Company claim that their new lamp does not infringe the second claim of the Edison patent, and their motion above referred to was for the purpose of securing a judicial opinion in that regard.

The motion for an order to show cause, made in behalf of the Westinghouse Company, was fortified by affidavits of George Westinghouse, Jr.; W. K. Carlisle; Frank S. Smith; O. B. Shallenberger and Daniel C. Ripley, tending to establish the proposition that the new Westinghouse lamp is not covered by the claim of the Edison patent; describing to a considerable extent the construction and process of manufacture of the new stopper lamps; and alleging that nothing was involved in the structure of the new Westinghouse lamp beyond an application of the instructions or information imparted by Sawyer and Man, and by them made a part of the art, in their patents prior to the date of Mr. Edison's invention in October, 1879, along with the use of good mechanical skill in following such instructions. It was also shown by defendants that they had in January submitted specimens of their new lamp to the counsel of the General Electric Company for examination, at the same time requesting their opinion upon the question of infringement; they also made affidavit that the new lamps were, about the middle of January, put upon the market and had since been sold and shipped in considerable quantities, in the regular course of the defendant company's business, under advice of their counsel.

The complainants submitted affidavits by J. H. Herrick, S. D. Greene and F. R. Upton. Mr. Herrick in his affidavit includes as exhibits, circulars of the Westinghouse Company, issued at various times since October 6th to users of incandescent lamps, alleging that their new lamps not only did not infringe the Edison patent, but were fully covered by patents of their own, and that they would presently be prepared to supply the market in large quantities and at prices very much below those generally prevailing. Mr. Herrick's affidavit alleged further that by means of misrepresentations as to its ability to supply the trade with lamps at greatly reduced prices, and by other inducements, the Westinghouse Company had endeavored to prevent the complainants from securing the benefits of the successful termination of the Edison patent litigation.

Mr. Greene's affidavit set forth his disbelief that the new Westinghouse lamp had gone into commercial use anywhere. He had not heard of a single plant which had received such lamps.

Mr. Upton testified that samples of the Westinghouse lamp had been turned over to him for testing and the determination of the process of construction and mode of operation, but the number of lamps submitted had not been sufficient to enable him to make systematic tests.

Mr. Grosvenor P. Lowrey made the argument for the complainant and Mr. George H. Christy for the defendant.

Mr. Lowrey said, in support of complainant's motion to dismiss, that the question of infringement was too vast to be taken up and disposed of upon such a motion. It should be brought up by a supplemental bill or an original suit; he did not think it would be a proper course to serve the defendant with an attachment for contempt of court for use of the stopper lamp, as the question of infringement was so difficult a one to determine. The complainants ought to have more time to examine the construction and operation of the new Westinghouse lamp, and required many more samples of it for examination than they had yet been supplied with; and they were willing to pay for them.

Mr. Christie urged a prompt decision upon the complainant's motion to dismiss so that the main question of infringement could be reached as early as possible. In respect to the alleged novelty or unusualness of the present form of proceeding, he showed that for a long time it had been the practice in the Pennsylvania Circuit to allow the defendant under injunction to ask the court for a modification or a construction of the injunction order in precisely the manner now asked in this case.

The argument lasted through Thursday and Friday, and at its close the court took the papers, reserving decision.

The Westinghouse Company has also applied to the court for an order to restrain the complainant from bringing suit elsewhere, that is, against the Westinghouse Company's customers, pending the argument upon the order to show cause. That argument is, of course, deferred until the court decides upon the complainant's motion to dismiss.

GOVERNMENT ATTACK ON THE BERLINER PATENT.

A SPECIAL despatch from Washington, of February 9, says:—"Attorney-General Miller to-day filed a complaint in the United States Circuit Court for the District of Massachusetts, at Boston, against the American Bell Telephone Company and Emile Berliner. It is in thirteen paragraphs, and asks for an annulling of patent No. 463,569 for a combined Telegraph and Telephone applied for by Berliner on June 4, 1877, and issued November 17, 1891, to the American Bell Telephone Company as Berliner's assignee.

"The grounds upon which the application for annulling the patent is made are that the claims set up in the Berliner patent, granted in 1891, are covered by previous patents issued to the Bell Company, beginning with the original Bell patent, No. 174,465; that the possession of said patent No. 463,569, if valid, will continue to the Bell Company without substantial diminution during the full term thereof the same close monopoly of the art of telephony in the United States, which it has enjoyed under patent 174,465; and that it is against the spirit and intent of the patent laws, and against justice and equity, that the monopoly of one and the same invention shall be prolonged in one and the same person by the grant, first of a patent or patents, for the invention in practical and applied form, and afterward of a patent covering nakedly and broadly the fundamental principle of the same invention."

The complaint was presented by Mr. Robert S. Taylor, as special counsel. Mr. Taylor is a well-known patent lawyer of Fort Wayne, Ind.

TELEGRAPH LITIGATION—OPINION IN A LOTTERY CASE.

IN the case of the United Lines Telegraph Company and Edward S. Stokes, appellants, vs. the Boston Safe Deposit and Trust Company, on appeal from the United States Circuit Court for the Southern District of New York, the Supreme Court, in an opinion rendered by Justice Blatchford, has affirmed the decree of the lower court in favor of the Rapid Company. The dispute concerned the ownership of a line of telegraph between Cleveland and Chicago, one party claiming under a Rapid mortgage of $3,000,000, and the other under a mortgage from the Bankers' and Merchants' Company amounting to $10,000,000. Justices Brewer and Field dissented.

OBITUARY.

DR. NORVIN GREEN.

THE death is announced at Louisville, Ky., of Dr. Norvin Green, who has been president of the Western Union Telegraph Company since 1878, when he succeeded William Orton. The history of telegraphic combination, rather than of creation, is embodied in Dr. Green's career. He was born in 1818 at New Albany, Ind., and in 1840 graduated from the University of Louisville. He practiced his profession of medicine in Louisville for several years, but drifted into politics, and then early in the fifties became interested in the early Morse and People's Telegraph lines between Louisville and New Orleans. He made the telegraph a special study, and followed its fortunes so closely that when in 1866, the American, United States and Western Union lines were consolidated he became vice-president of the company, and held the office until 1873. Three years later he came back to the telegraph, and was again the vice-president of the new and larger Western Union. The sudden death of Mr. Orton in 1878, gave Dr. Green the commanding position he had so long been in training for, and which he was so well fitted to occupy. That he did his work well, the steady, magnificent, solid growth of the company shows. He liked his duties and held on until advancing age and sickness drove him back, for the last time, to his old Kentucky home.

Dr. Green was a giant in physique, of large social instincts, of judicial mind and executive turn, fond of a joke and good story, a great smoker and a great club man. He leaves a wife, four sons and two daughters. One of the sons married a daughter of Abram S. Hewitt. It is estimated that Dr. Green leaves a fortune of $2,000,000, chiefly in Western Union stocks. It deserves mention that Dr. Green was one of the founders of the American Institute of Electrical Engineers, and its first president, serving two consecutive terms. He took great interest in the growth of the Institute, and attended the council meetings with exemplary regularity.

TRANSPORTATION TO THE ST. LOUIS CONVENTION.

An excursion rate of a fare and a third has been granted to St. Louis and return for delegates attending the Convention of this Association by all the Passenger Associations except the Western; negotiations are now pending with them and in all probability they also will grant this concession. Arrangements have been perfected for a special train to carry the Eastern delegation, which will be vestibuled, electrically lighted, and composed of dining, buffet, observation and sleeping cars, and will leave New York, *via* Pennsylvania Railroad, from stations foot of Cortlandt and Desbrosses streets, Sunday, February 26, at 12 o'clock noon; Philadelphia, 2.25 p. m.; Harrisburg, 4.25 p. m. Pittsburg, 10.40 p. m. (central time); Columbus, 4.35 a. m.; Indianapolis, 10.30 a. m.; arriving at St. Louis at 5.30 p. m., Monday, February 27.

The rate for berths is $6.00 each; drawing-rooms, $22.00 each.

For the convenience of passengers taking this train from New York, arrangements have been made that if they will remit to the undernamed the amount of railroad fare ($24.25) with the sleeping-car fare ($6.00) a receipt will be mailed them that will be honored by the railroad company for checking baggage, ferry passage, and passage through the gate at Jersey City, and exchangeable on the train for regular railroad ticket and certificate.

The Boston Passenger Committee have declined to sell tickets at a reduced rate from Boston *via* New York; therefore the Eastern delegation who desire to take the Electrical Special will be compelled to come to New York, purchase tickets and secure certificates from New York to St. Louis and return. It is quite important that all the names of delegates who will be passengers on the Electrical Special shall be known as soon as possible.

The following named gentlemen have charge of transportation matters for their various territories: Morris W. Mead, Pittsburg, Pa.; Fred. W. Royce, Washington, D. C.; H. A. Cleverly, Philadelphia, Pa.; A. C. Shaw, Boston, Mass.; John Carroll, Montreal, Can.; M. J. Hart, New Orleans, La.; John W. Flintham, Denver, Col.; J. Scribner, 173 Adams street, Chicago; Louis Nahm, St. Louis, Mo.

To secure the benefit of the reduced fare returning, it will be necessary for those who do not go by the Electrical Special to be sure and state to the ticket agent from whom they purchase the going ticket that they purpose attending the meeting of the Association at St. Louis, and procure from him a certificate which will entitle them, when properly viséd and countersigned, to return for one-third the regular fare. No reduction can be obtained without this certificate. Immediately upon arriving in St. Louis these certificates should be left in the Secretary's office, addressed to C. O. Baker, Master of Transportation, who will see that they receive proper attention and are returned to the owners.

TELEPHONE MEETING OF THE NEW YORK ELECTRICAL SOCIETY.

At the meeting of this Society, held at Columbia College on February 8, a large gathering of members and visitors assembled to listen to a lecture on "The Telephone, and how we talk from New York to Chicago."

The lecture was divided into two parts, the first of which comprised what may be termed the philosophy of the telephone. This part was given by Mr. J. J. Carty, chief electrician of the Metropolitan Telephone and Telegraph Co. of New York. Mr. Carty began by explaining the nature of sound and the mechanism of speech, showing the functions of the various parts of the throat, mouth and teeth in the utterance of intelligible sounds. He then showed how sound may be propagated directly through the air, or by means of liquid or solid conductors, and finally by the aid of electricity. In leading up to the Bell receiver Mr. Carty explained the mechanical and electrical principles involved in its operation, and also gave a lucid explanation of the battery transmitter and the variable carbon contact.

Mr. Carty was followed by Mr. F. A. Pickernell, chief engineer and electrician of the Long Distance Telephone Company, who described the methods of construction adopted in the design and erection of the long distance line between New York and Chicago. Both Mr. Carty's and Mr. Pickernell's remarks were illustrated by stereopticon views.

Through the courtesy of the Long Distance Company the Chicago line had been run into the lecture hall with forty receivers in circuit. At the conclusion of Mr. Pickernell's remarks an exhibition was given, including the transmission of speech, cornet and banjo from Chicago. Notwithstanding that forty receivers were in circuit, the volume of sound was such as to leave nothing to be desired. The members and visitors present, with one accord, expressed their delight with the evening's entertainment.

The New York Electrical Society is rapidly increasing in membership, and its work is being more and more appreciated.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE ANSONIA ELECTRIC COMPANY.

Changing the name of an old established business would seem to the man outside very like swapping horses in mid stream, but to those who are acquainted with the facts and know to some extent the causes that have led up to this step it will not seem so strange to know hereafter The Electrical Supply Company by a new name. We think there is hardly a man or a boy in the country from the manager or president of the biggest central station or electrical railway, to the ambitious youngster who has been striving to make the wheels go round with a few inches of fine wire and some scraps of iron, but who has heard of or known more or less intimately The Electrical Supply Company. of Ansonia, Conn., and Chicago. Hereafter the organization that has established and conducted an immense business under that name will be known as The Ansonia Electric Company. Some of the reasons for this change of name may be briefly given. While this company was the first to assume the name incorporating the words "Electrical Supply" and while by all rules of precedence it considers itself entitled to the undivided use of those words as applied to a company name, it seems that the very nature of the business and the expensive methods that have been employed to make the name known have served also to establish in the minds of the general public an understanding that it is a descriptive name applying to a large class of similar enterprises rather than to one special, distinctive organization, so that many times in referring to the source of certain supplies it would be asked, *Which* "electrical supply" company? During the past few years many concerns have been started all over the country calling themselves this or that "Electrical Supply" Company. While many of these, no doubt, had no thought of appropriating a proprietary name there have been others that have, it is feared, sought and intended to profit by the similarity of titles. This has been of considerable annoyance to the originators of the name.

The managers of The Electrical Supply Company finally determined that it would be best perhaps to change the name. Nothing else but *a change of name* was contemplated and no other changes whatever have been made either in the organziation or the personnel of the company. No consolidations of other concerns and no new relations have been contemplated or established. Under the wise management of its two divisions, the factories in Ansonia, and the salesrooms and warehouses in Chicago, the business has grown to very large proportions. Extensive improvements and additions to the factories in Ansonia have been planned and partly consummated, but it was thought to be a provident and wise thing to assume a name about which there could be no possible doubt or dispute as to its rightful ownership. There is no name in the United States more familiar to the business or electrical field than that of Ansonia. It is known quite as well as New York, Boston, Detroit, Minneapolis, Omaha, Kansas City, New Orleans or Chicago, although perhaps it is not so commonly talked of as Chicago to-day. In the minds of pioneer electric men Ansonia will ever hold a warm place. Among the men who are now prominent in the development of the electric science many have made pilgrimages to Ansonia in the quest of information or to confer with the man to whom can be traced the first practical ideas of the commercial advantages of electric lighting. They who are reading the articles in The Electrical Engineer by Mr. W. J. Hammer, on the work of William Wallace, will have seen how important his work was. It was in Ansonia that the first dynamo was built in this country. It was in Ansonia that the first electric light was used commercially. It was there that Mr. Edison first saw it and there he got the machine to conduct his first experiments. It was an Ansonia built machine that was exhibited at the Philadelphia centennial and furnished the only electric lights shown at that great exposition. It was this same machine that Charles Brush spent weeks examining at the exposition and from which he derived many of his most valuable ideas. In Ansonia the first electric light carbons were made by Mr. Wallace, and he there originated the idea of copper plating them. Hence Ansonia is and must always be in the minds of the older electric people associated with the early days and rise and advancement of a new and great industry.

The name The Ansonia Electric Company is one which very properly belongs to and fits a company that had its start in Ansonia and was established under the guidance of the man and his sons who were so thoroughly and clearly pioneers in the business. Under its new name and its old management, the Ansonia Electric Company has our warmest wishes for its continued success.

The F. P. Little Electrical Construction and Supply Company is the present style of the firm of F. P. Little & Co. The company propose to continue the engineering business of the old firm but on a much larger scale. Mr. Little will continue to be the manager of the company.

CARPENTER ELECTRIC COOKING UTENSILS.

THE CARPENTER ELECTRIC HEATING MANUFACTURING COMPANY of St. Paul, Minn., are introducing a constantly increasing number and variety of cooking utensils provided with their well-known heaters, and so constructed that the most ignorant "Biddy" is in no danger of accidental short-circuits or similar disasters.

The accompanying illustrations represent three of the most important of the new apparatus. The broiler, Fig. 1, is made in two sizes, the small size consuming about seven amperes on 110 volts, and the large one about 12 amperes on 110 volts, and from a cold iron, after turning on the switch, will become sufficiently heated in from three to four minutes so that broiling can be completed on them in less than five minutes. They are constructed with a little slant, so that they may drain to one point at the middle of the lower end.

The baking oven, Fig. 2, is 18 inches long, 14 inches high and 12 inches deep, made of well-seasoned white pine, lined with asbestos felt, and bright tin. There are two sheet-iron shelves in each oven, and also two resistance plates on the bottom and one on the top, connected with a switch on the outside of the oven, so that two temperatures may be obtained. These ovens have a small glass window in each door, so that the baking can be watched. Each resistance plate consumes about five amperes on 110 volts, and it has been found that it only requires from 12 to 15 minutes, at a maximum temperature, to heat the oven to 250° Fahrenheit. The current can then be turned off and the baking continued.

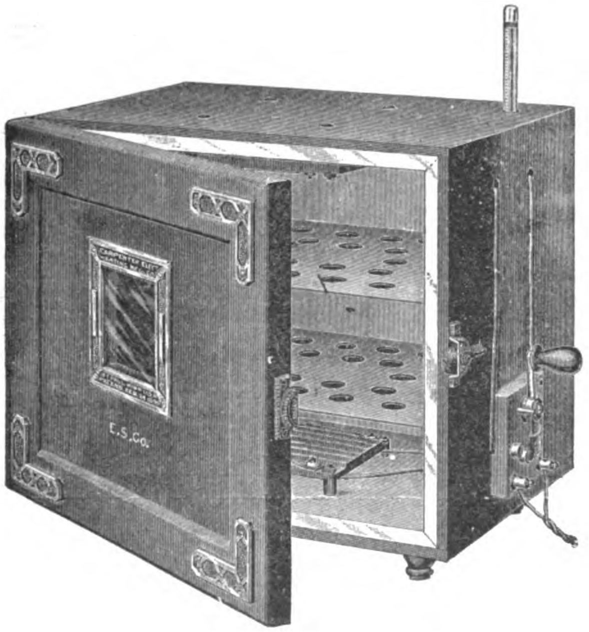


FIG. 2.—CARPENTER ELECTRIC BAKING OVEN.

Fig. 3 shows the chafing dish which requires no special description, but must be very highly appreciated by anyone who has been cheated of a Welsh rarebit in the early morning hours all because there was no alcohol in the house.

The company make also glue pots, curling tongs heaters, sealing wax heaters, flat irons, etc., besides their radiators and car heaters that have already become so widely known, and publish circulars fully explaining their use. The implements are made of excellent material, and in a thoroughly workmanlike manner.

DE RYCKE SEPARATORS.

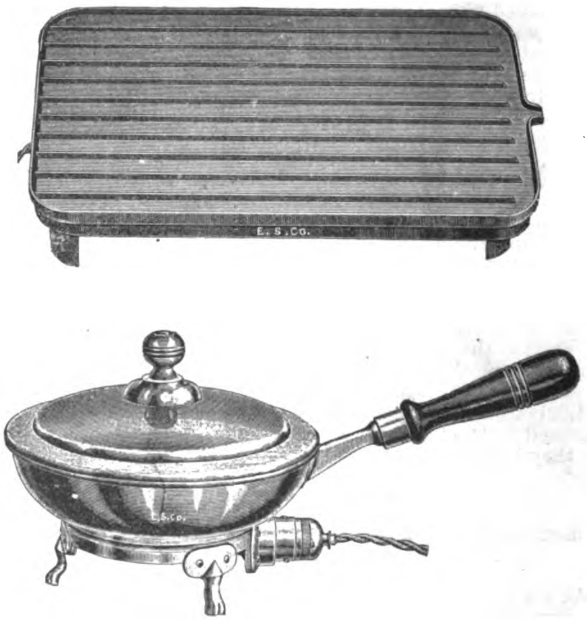
JOSEPH DE RYCKE, 145 Broadway, New York, manufacturer of the De Rycke centrifugal separators and grease extractors, reports that business is very good. Among his recent sales are the following: 44 to Risdon Iron Works, San Francisco agents; 27 to the Crane Company, Chicago agent; four to Willis H. Post, Fort Worth, Texas agent; six to Juan C. Escalar, Cuba agent; four to Bath, Me. Iron Works, for a United States gunboat; one order for 12, a second order for two, a third order for 22, and a fourth order for four, making a total of 40 separators and grease extractors, ranging from three to 12 inches in diameter, to the Milwaukee Street Railway; one order for 12 and a second order for two, ranging four to 18 inches in diameter, to the Cincinnati Edison Electric Company; a twentieth order to Copeland & Bacon, Mining Engineers, 85 Liberty street, New York; six to the Boston Electric Light Company; one to the Newport Electric Light Company; one to the Edge Moor Iron Company; a third order to W. & A. Fletcher Company; a third order to the New Haven Heating Company; one to Chas. S. Salomon; one to George I. Rockwood; two to Fitchburg Steam Engine Company; two to Levi P. Morton; two to the Waco Electric Light Company; one to Liverpool, London and Globe Insurance Company; one each to steamers, "City of Taunton," "John D. Schoonmaker" and "Harry;" a third order to Sulphur Mines Company; one each to the New York & Rosendale Cement Company and the Peabody Electric Light Departement.

THE ELECTRICAL AND MECHANICAL ENGINEERING AND TRADING CO.

THE incorporation last week at Albany is announced of the Electrical and Mechanical Engineering and Trading Company of New York City; to act as consulting, contracting and constructing engineers, for electrical and mechanical construction and to deal in apparatus, materials, etc. Capital $150,000. Directors—J. H. Vail, George F. Sandt, Westfield, N. J.; U. T. Fackenthal, Brooklyn; J. H. Miller, Mount Vernon, and H. Wray Weller, Jamaica.

MASON REGULATOR CO.

A very pretty souvenir and clever advertisement has just been issued by the Mason Regulator Company, of Boston, manufacturers of steam Regulating devices. It consists of a folder representing a U. S. mail bag, with padlocks, rivets and all the rest of it, so correctly reproduced and colored that one seems to be looking at the real thing from a distance and instinctively wonders what there is in it for him.



FIGS. 1 AND 3.—CARPENTER ELECTRIC BROILER AND CHAFING DISH.

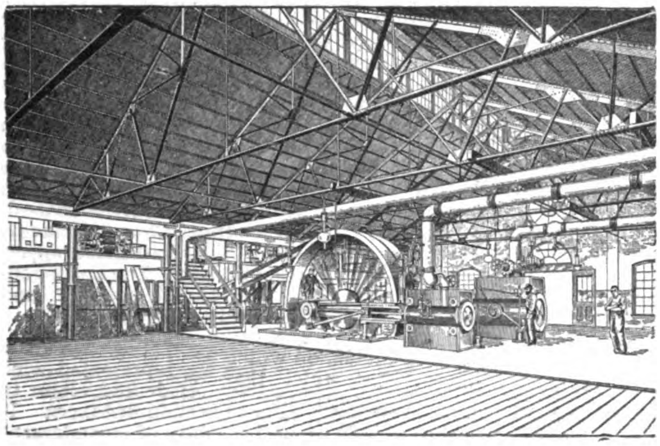
"HE MISSED IT BADLY."

IN beginning his subscription again, a reader in Pennsylvania says: "I felt as though my best friend was dead when your paper ceased coming."

THE AUBURN ELECTRIC MOTOR COMPANY, are having hard work to keep up with their orders in their present limited quarters. The building recently purchased by them for a factory will be ready for their occupancy in about a mouth, which will be fitted up with new and modern machinery. For temporary use they will use a large electric motor of their own make, to run the shop, until frost gets out of the ground so they can set the boilers and engine A 50 h. p. engine will be put in. The company has recently built a plating dynamo for T. L. Caltaud, Lewiston, and are at work on a 4 h. p. 600 volt motor for Bowie Bros.' shoe factory; also a 25-light dynamo for agent Geo. W. Bean of the Androscoggin Mills, to light his residence, a water motor in his cellar furnishing him with the necessary power. A 20-light dynamo has just been completed for lighting J. B. Ham & Company's grist mill, Lewiston, which will be replaced later by one of larger capacity. The company has a number of other orders on hand, and almost every day adds to the list.

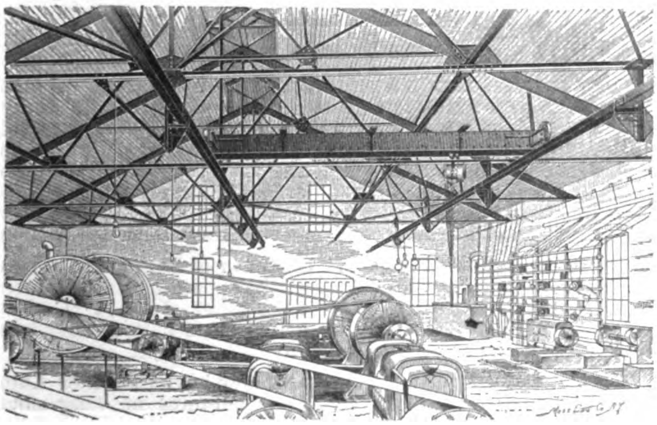
TWO NEW ELECTRIC LIGHT STATIONS WITH IRON ROOFS.

One of the finest electrical plants in the United States is that built by the Pawtucket Gas Company at Pawtucket, R I. The above illustration is taken from a photograph in the engine-room, and shows but a small part of the entire plant. This view is taken in the engine-room more particularly for the purpose of showing the roof which was designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn. The peculiarity in the construction of the roof is that it is covered with their patent anti-condensation corrugated iron. In a place of this kind it is absolutely necessary that not a particle of water should drip from the roof trusses, and the Berlin patent was adopted in order to prevent condensation on the underside of the roof. It has worked perfectly and after being in use during two winters, the present winter being very severe in the vicinity of Pawtucket, R. I., it has shown no signs whatever of any condensation on the underside. The same kind of roof was used on the new station for the Narragansett Electric Light Company, at Providence, R. I., with equally good results, and we understand that the Berlin Company have adopted it universally for electric light stations and other places where drip from the corrugated iron is injurious. If this problem has been solved in such a simple and economical manner, the Berlin Company are to be congratulated. This has been a great trouble with iron roofs in the past, as readers of The Electrical Engineer will remember.



Engine Room of the Pawtucket Gas Company.

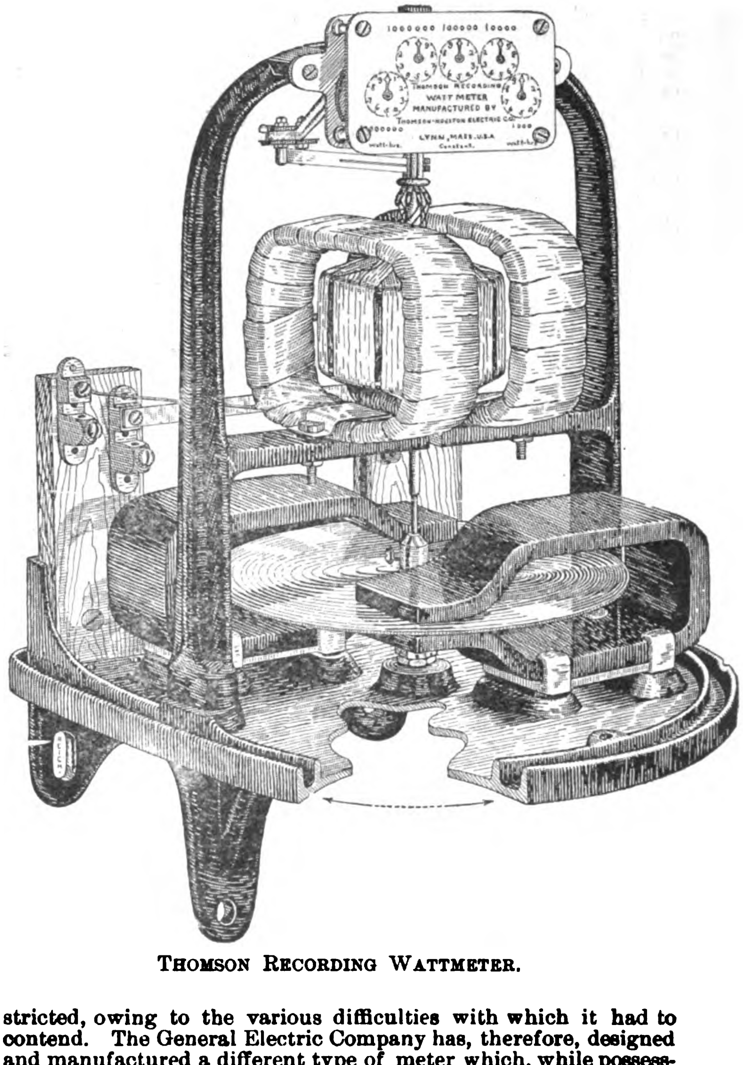
The other illustration is taken direct from a photograph and shows a unique roof construction which we are glad to call to the attention of our readers. It is an iron roof designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn., for a dynamo-room for the Norwalk and South Norwalk Electric Light Company, of Norwalk, Conn. The roof itself is of the well-known Berlin pattern. The building is 60 feet in width and 70 feet in length. It was desired to have a power crane for moving the dynamos in and out of position, but owing to the extreme width of the building (60 feet) a traveling crane was too expensive, especially in view of the fact that it was only desired to control a limited portion of the floor space. To meet this condition the Berlin Company designed the roof trusses in such a way that the traveling crane girders could be secured to the roof trusses at two points, allowing a crane of about 16 feet span to be used with a travel the full length of the building. This crane controls a floor space of 16 feet of the width of the building and the full length, which was all that was desired, and brought the expense for power to move the dynamos in and out to a very economical point. The traveler has a motion on the crane girder lengthwise the full length of the building, and sidewise the motion is secured by a trolley on the crane to which an ordinary chain hoist is attached. The capacity of the traveling crane is 4,000 pounds, which is amply sufficient for all ordinary purposes.



Dynamo Room, Norwalk & South Norwalk, Conn., Electric Light Co.

MOISTURE, GAS AND DUST PROOF THOMSON RECORDING WATTMETER.

The use of the ordinary type of the Thomson recording wattmeter, under abnormal climatic or other conditions, has been restricted, owing to the various difficulties with which it had to contend. The General Electric Company has, therefore, designed and manufactured a different type of meter which, while possessing all the advantages of the well-known meter as used all around us, has special features which enable it successfully to meet the altered conditions.



Thomson Recording Wattmeter.

It is especially designed for service in hot climates where atmospheric influences are corroding, and mephitic gases, damp vapors and minute insects prove detrimental to the ordinary type of recording meter. A glance at the cut will show wherein it differs from the ordinary type. It is a skeleton meter. On the upper side of the lower plate is a groove running completely around it, and in this the cover sets. The groove is filled, after the cover is in place, with heavy oil, gum or cement, preferably a heavy oil. The hole in the base through which the sealing plug of the meter passes is hermetically sealed by means of a soft rubber washer under the wing-nut, while the leading-in and leading-out holes are closed around the wires by a rubber diaphragm through which the wires are punched on being entered.

These meters are especially useful in such places as chemical factories, dye houses, and elsewhere, and, as they fill a great want, should find a large demand. They are made in all standard sizes up to 150 amperes, and all voltages up to 100 volts, for two wire system only, and are known as Type "T."

THE JOS. DIXON CRUCIBLE COMPANY.

THIS company have recently issued a new catalogue containing 36 pages and describing exactly 100 styles of their pencils, crayons and erasers. While no attempt at ornamentation has been made, the pamphlet is well printed and clearly illustrated with excellent wood cuts.

The Dixon Company own what are said to be the only successful graphite mines in America, situated at Ticonderoga, N. Y. They also own a large waterpower at the outlet of Lake George into Lake Champlain, where they have a mill six stories high and ninety feet square for the perfecting of their graphite.

WESTERN NOTES.

THE following new buildings in Chicago are being equipped throughout with okonite wire and interior conduit. Ellsworth Building, Teutonic Building, Boyce Building, Strickland Hotel, Columbus Building and Chicago Athletic Club.

The Central Electric Company, 118 Franklin street, are western agents for both of these products and report business very brisk and coming their way.

The Lundell motor also takes with the people and the outlook in this line is reported very promising.

F. G. Fuller, who for the past seven or eight years has been identified with the interests of the Edison machine works and the Edison General Electric Company, and for the past two years has held the position of western sales agent for the U. S. Wire & Cable Co., has resigned the above position, his resignation to take effect March 1st. After the above date Mr. Fuller's old friends will find him at Worcester, Mass., in the home office of the Washburn & Moen Mfg. Co. Mr. Fuller has accepted a lucrative position with the above company. His long experience in the cable line of the wire business means that the Washburn & Moen Co., have secured a most desirable acquisition to their representative force.

THE ELECTRIC APPLIANCE COMPANY are congratulating themselves on the way business has kept up through what is usually a very quiet month in the electrical supply line. They state that the demand for their standard specialties, among which might be mentioned Paranite Wire, Elkhart Transformers, Whitney Instruments, etc., continues to grow even when a quieting down of business might be expected. It should be mentioned with regard to the recent article in THE ELECTRICAL ENGINEER giving the allotment of space at the World's Fair that the Electric Appliance Company have secured a magnificent location several hundred square feet in extent and that they will make there a brilliant and notable display—one of the finest in Electricity Building.

D. B. MARTIN, general passenger and ticket agent of the three C's and St. L. railway company, better known as the "Big 4," is sending out some most desirable information to all parties contemplating a trip to the South.' Beyond doubt, the Big 4 possesses advantages not possessed by any other southern route. The company are dispatching magnificent solid vestibuled trains, steam-heated, equipped with palace sleeping cars, reclining chair cars and a thorough dining car service. In fact, everything is done to make this trip what is contemplated—a "Trip of Pleasure." Mr. Martin's headquarters are at Cincinnati in the large and handsome office building of the Big 4 company.

THE CENTRAL ELECTRIC COMPANY received an order last week by telegraph for 30 miles No. 4 weatherproof wire, the conditions of the accepting of the order being that it would be shipped on the same day. The order was filled out of its own stock, and the Central can be congratulated on being able to handle business of this magnitude in so prompt a manner. The Central Electric Company hope to have their new catalogue finished by April 1st, and beg the indulgence of their patrons, assuring them that they will be well repaid by waiting, as the book is expected to be the very finest in the catalogue art.

LOGANSPORT, IND.—The local *Daily Pharos* has a very appreciative item on the new plant of the Logansport Electric Light and Power Company and especially on the fine new 150 h. p. engine put in by the Ball Engine Company of Erie, Pa. The tests made by Mr. D. M. Seymour, of the Ball Company, with Messrs. Muir and Driftmeyer, for the Fort Wayne Company, were most satisfactory. The indicator cards were beautiful.

BUCKEYE LAMPS. The Chicago office of the Buckeye Electric Company is taking care of an immense amount of business, a large stock of standard voltage "Buckeye" lamps being carried at that point, which means prompt delivery, something duly appreciated by central station people.

THE RISDON IRON WORKS, of San Francisco, Cal., have been appointed Pacific Coast agents for De Rycke separators and grease-extractors manufactured by Joseph De Rycke, 145 Broadway, New York City.

DR. JOHN MCKINLOCK, has been appointed Medical Director in Chicago for the Commercial Alliance Life Insurance Company of New York.

MR. GEORGE CUTTER is back from an eastern trip during which he closed some large contracts for enamel rheostats and heating devices.

NEW ENGLAND NOTES.

PETTINGELL-ANDREWS COMPANY, of Boston, as stated recently in our columns, were recently appointed New England agents for the Siemens-Halske Company of America, and are making preparations to handle this business on a large scale. At a recent session of the Vermont Legislature, a charter was granted for a street railroad between Bellows Falls, Vt., and Paxton River village, a distance of five miles. A contract was closed and signed by the ten incorporators of the road, ceding their rights to the Pettingell-Andrews Company, who agree to build and have ready for use within two years, a substantial electric road between the two villages. Siemens-Halske apparatus will doubtless be used, and it is reported that the Pettingell-Andrews Company have a number of places where they will install Siemens-Halske apparatus as soon as they can get delivery from Chicago. The Pettingell-Andrews Company have now several very valuable agencies, and are rapidly increasing their business to a very large extent.

THE DAVIS ELECTRICAL WORKS, of Springfield, have issued a very neat little calendar for 1893, on which are represented some types of incandescent lamps, which they repair and claim to "make as good as new,"—perhaps better in certain instances. It is an important work, especially so in these days of incandescent lamp litigation, and everyone should familiarize himself with their method and prices.

THE BROWN ELECTRIC COMPANY, of Boston, have now got thoroughly settled in their convenient quarters at the corner of Summer and Federal streets, and have already done a most satisfactory business during the first month of their existence. "Salamander" wire, which this company sells in Boston and vicinity, has just been put on the list of wires accepted by the Boston Board of Fire Underwriters.

THE SAWTELL COMPANY, of Boston, the New England agents for the Davis Electrical Works of Springfield, who make a specialty of renewing burned out incandescent lamps, have removed their offices to room 10, Shawmut Building, 146 Franklin street. The location is more central for electrical business, and they will have more facilities for handling their rapidly increasing business.

THE CONSOLIDATED ELECTRIC MANUFACTURING COMPANY, of Boston, have recently issued a price list of arc lighting apparatus. They are now prepared to furnish arc dynamos of from 25 light to 90 light capacity, requiring from 20 to 42 h. p. The price list includes arc lamps, single and double carbon, and all other necessary apparatus for a complete arc lighting system.

MR. F. A. SWAN has succeeded to the business of Swan & Lane, and will hereafter conduct the business alone. Mr. Lane retires with the best wishes of all his friends, and Mr. Swan will doubtless continue to have the business support of all the old patrons of the firm, and carry on the business as successfully in the future as in the past.

CUMNER, CRAIG AND COMPANY, of Boston, have been appointed New England agents for the well-known Bishop high grade rubber insulated wires. All electricians will be glad to know that this wire is again represented in this territory, and that it is in efficient hands.

PHILADELPHIA NOTES.

THE COMMONWEALTH ELECTRIC COMPANY has removed from 606 Arch street to much more commodious quarters at 418 Market street where they will occupy the entire first floor and basement, In addition to the manufacture of dynamos and motors the company will do construction work and deal in general electrical supplies. They have met with remarkable success considering the short time they have been in existence. Mr. C. L. Crosby, their solicitor, is one of the most competent electricians in this section.

THE RIES ELECTRIC SPECIALTY COMPANY of Baltimore has been appointed sole agent for the sale of all the apparatus manufactured by the La Roche Electric Works for the states of Md., D. C., Va., W. Va., N. C. and S. C. Several installations have already been reported by this enterprising company.

THE PARTRICK & CARTER COMPANY now have their new Automatic Annunciator, illustrated in our columns not long since, ready for the market and they are filling the many advance orders received for them.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XV. FEBRUARY 22, 1893. No. 251.

WILLIAM WALLACE, AND HIS CONTRIBUTIONS TO THE ELECTRICAL INDUSTRIES.[1]—IV.

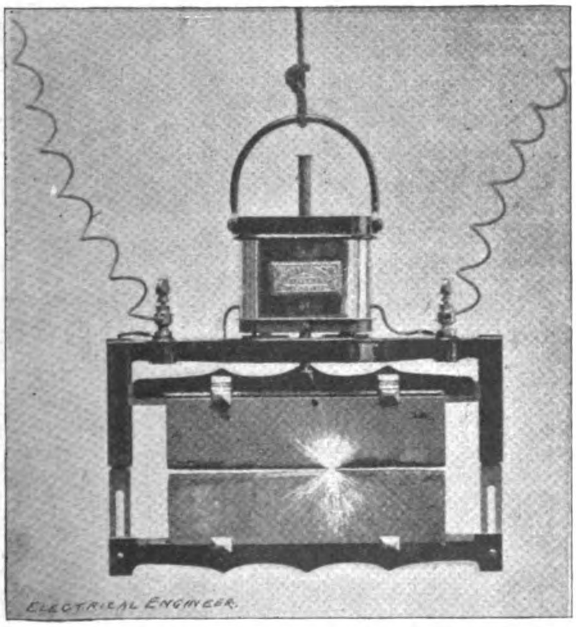
BY

Wm J Hammer

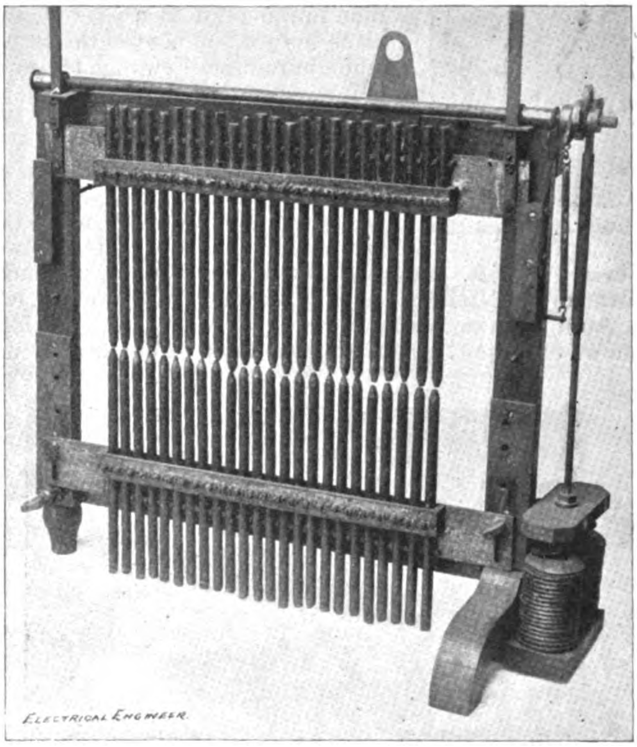
(Concluded.)

XI.

THE first installation in which arc lamps were run in series was made with the Wallace plate carbon lamps in his factory at Ansonia; and following this in the Fall of 1879, at the American Institute Fair, Mr. Wallace showed four and more lamps running in series. At this time Charles F. Brush, the well-known electrician, was inaugurating his work, and placed in the American Institute Fair four lamps run in separate circuits, and which shortly thereafter he succeeded in running in one circuit. At the Mechanic's Institute Fair, held somewhat later, a comparative test was made between the Wallace and Brush systems, and Professor Trowbridge, of Harvard College, awarded the medal to Mr. Wallace, stating in his report that the high resistance of the dynamo made it more suitable for running lamps in this manner. An interesting test was made at the Franklin Institute in Philadelphia under the auspices of Professors Thomson and Houston, who have since become so universally known through their electric lighting work. These tests were a comparison of the Gramme, Wallace and Brush machines, and it is claimed that they did not show as high an efficiency for the Wallace machine as they should have, due to the lack of knowledge at that time of the important relation of the resistance of the internal portion of the circuit as compared with the external. With the perfect knowledge and accurate character of the testing instruments which are in the possession of the electrical engineer to-day, it seems almost incredible that the early workers in the electric lighting field should have secured such splendid results as they did. Mr. Wallace informs me that their apparatus for testing the dynamos at the factory consisted of a galvanometer and a coil of iron wire, the usual test being that a dynamo should generate sufficient current to burn off a certain length of a given gauge of wire, or it was not up to the requirements, and the essential changes were made in the connections, windings, speed, etc.



Standard Wallace Plate Lamp.



Wallace's 48 Carbon Arc Lamp.

In the subsequent lamps the carbon plates were shortened and made much wider, and the upper, or positive, carbon, which consumed nearly twice as fast as the lower, was made considerably thicker and the edge became hollowed out where the crater formed and threw the light down. A lamp of this type is shown on this page. Mr. Wallace was the first man in the United States to undertake the manufacture of carbons, and claims that he invented the round pencil of carbon now so universally used, and the appli-

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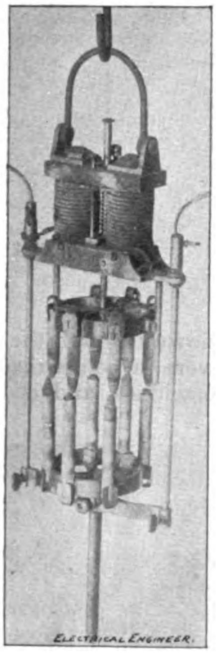
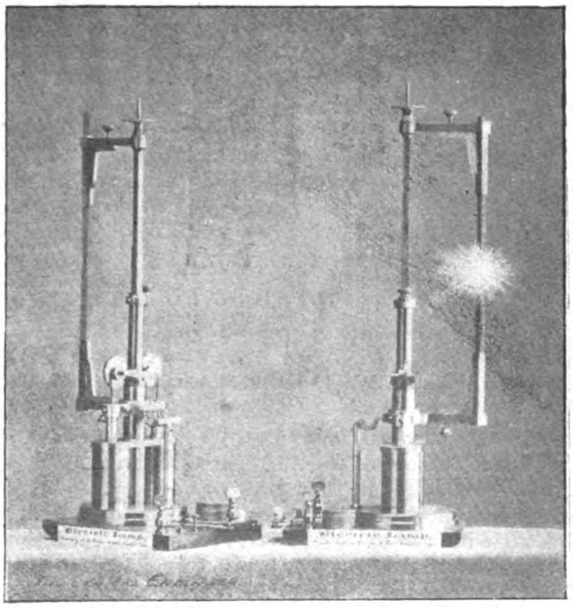
[1] Copyright, 1893, by W. J. Hammer.



Wallace's 12 Carbon Lamp.

ances for producing the same, antedating Carré and others abroad. Up to the time of his experiments in this direction, all the carbons used in this country were imported and consisted of square pencils sawn from gas retort carbon, a tedious and expensive process. I believe the imported pencils cost 75 cents each; much better ones made to-day cost but half a cent each. The carbons were very impure and several saws would frequently be used up in cutting one stick or pencil. The great improvements in the arc lamps of to-day are far more due to the improvement in carbon manufacture than in the perfection of the apparatus to feed and control the carbons while burning. Few men to-day are better posted in the details of carbon-manufacture than William Wallace. He erected an immense plant at the works of Wallace & Sons, capable of turning out 40,000 carbons per diem, and many of the tools and processes employed to-day were devised by him. Subsequently he disposed of the carbon plant to the National Carbon Company, of Cleveland, O.

An interesting modification of the Wallace plate lamp is shown on page 179, in which no fewer than 48 carbon pencils were employed, 24 above and 24 below, the arc moving from pencil to pencil as they burned away, and the feed being controlled by the magnet shown, in a manner somewhat similar to the plate lamp. This lamp was constructed in 1877. He also built a "V" lamp having two carbons above and one below.

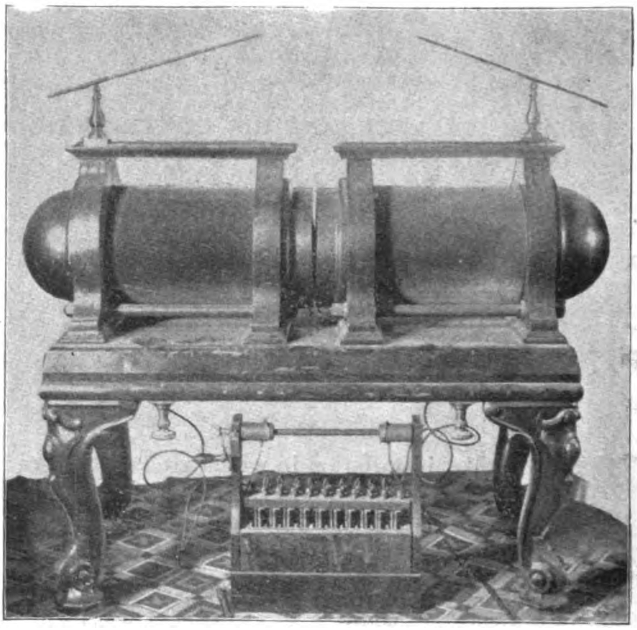


WALLACE'S IMPROVED CARBON PENCIL LAMP.

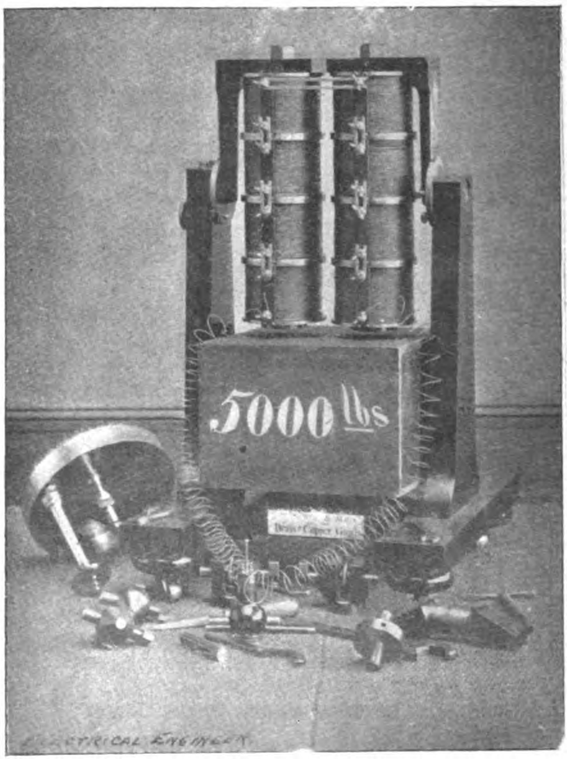
Other types of lamps are shown on this page. One of these is a twelve carbon lamp, six carbons being mounted upon both the upper and lower rings. This lamp is still in use to-day in lighting Mr. Wallace's private laboratory and works very satisfactorily.

XII.

The great Wallace induction coil, of which an illustration is presented on this page, is the largest induction coil ever made in this country, and, with the exception of the great Apps or Spottiswood coil in England, is the largest in the world. It was begun by Mr. Wallace in 1869 and completed in 1871. It is over five feet in length and twelve and a half inches in diameter, and with its condenser weighs over fourteen hundred pounds. It will give a 27-inch spark with a small battery of 6 Grove cells. The secondary coil consists of 95 miles of No. 36 B. & S. gauge wire. It was wound in sections like very narrow rolls of ribbon, so that no two portions of the wire of great difference of potential would come near together, a method often credited to Ritchie of Boston, who, however, only modified the plan probably first suggested by Poggen-

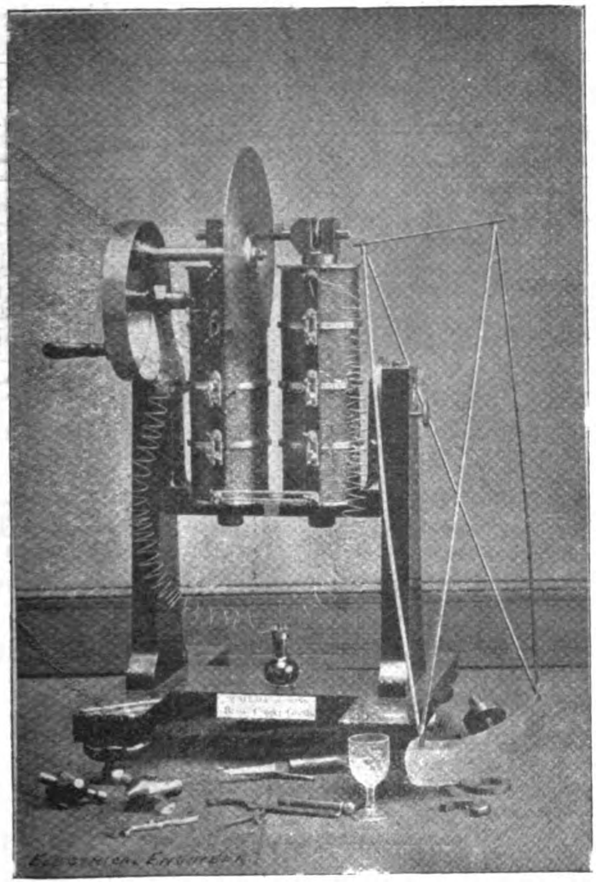


THE GREAT WALLACE COIL.



WALLACE MAGNETS.

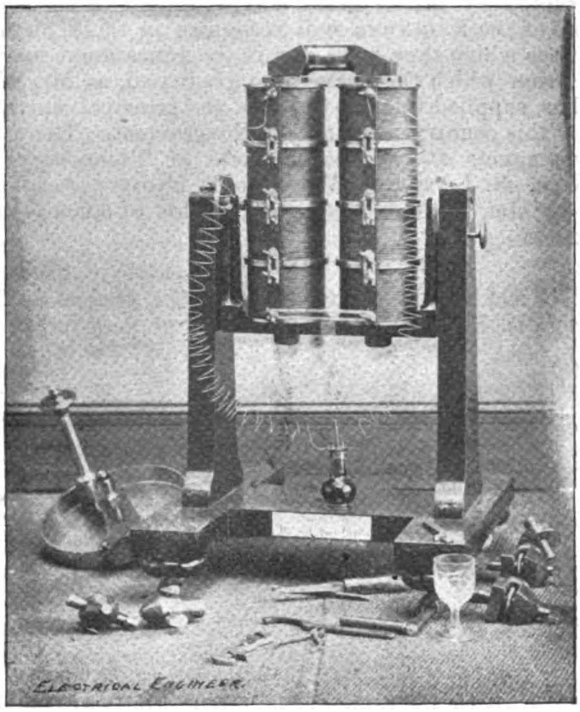
dorff in 1854, although two years previously Charles and and Edward Bright, of England, patented a similar method of winding electro-magnets. Almost the entire winding of these coils and the construction of the paraffine sheets and tin-foil for the condenser was done by Mr. Wallace's wife and his daughter Eloise, the winding being done upon a sewing machine rigged up for the purpose. Nearly three years were occupied in the construction of this immense coil and many interesting experiments were conducted by Mr. Wallace and others with it, until during some tests to determine the maximum spark which the coil was capable of producing, the insulation of the secondary was pierced and the coil damaged. The coil is still in existence in Mr. Wallace's private laboratory, and will give a considerable spark, although nothing like its original capacity. Mr. Wallace believes that it would be impossible to repair this break without unwinding much of the coil, but its efficiency might be increased by immersing the entire coil in oil. I have been informed from a reliable source that a similar accident has happened to the celebrated Apps coil referred to, which at one time would give a spark 42 inches in length with a battery of 30 Grove cells. The coil was 37.5 inches long, 20 inches in diameter and weighs alone 1,500 lbs. The wire in the secondary was 280 miles in length, and the total number of turns 341,850. It was completed in 1876. Doubtless the recent work of some of our scientific men, notably that of Prof. Elihu Thomson, precludes the possibility of the construction of large coils of this type hereafter.



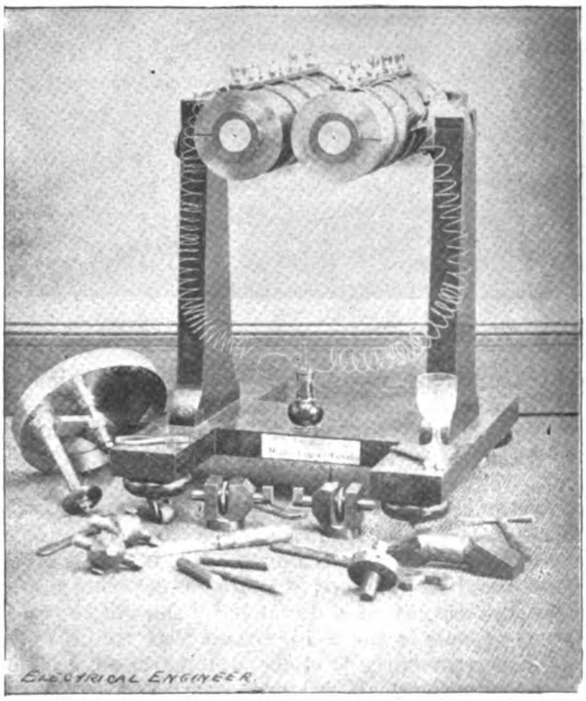
Wallace's Experimental Apparatus.

XIII.

In storage battery work Mr. Wallace and his brother Thomas have spent a large amount of time and money, though, like many other workers in this field, the results have been sadly disproportionate to the outlay. In conjunction with Prof. A. K. Eaton, the well-known chemist, they took out a large number of patents for improvements in storage or secondary batteries. These had mainly to do with mechanical modifications, but the feature which seemed most promising was the treatment of red lead, or minium with acetic acid which dissolved the lower oxide and formed the higher oxide, acetate of lead. For the other electrode a plate of zinc was used upon which lead was deposited in a spongy form. It was thought that this arrangement would do away with the tedious process of forming the plates, and yield really a primary secondary



Wallace's Experimental Apparatus.



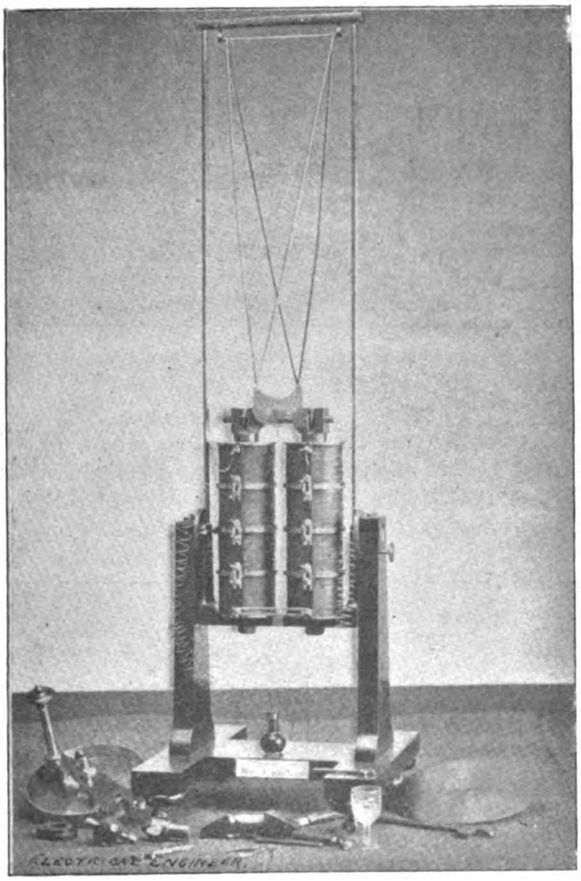
Wallace's Experimental Apparatus.

cell, but it did not realize the expectations of the inventors.

On this and preceding pages are shown sets of apparatus for experiments in magnetism and electricity, devised and constructed by Mr. Wallace, and doubtless many of the readers of the ENGINEER will recognize in these pictures apparatus which they have seen in the educational institutions from which they have been graduated, as Mr. Wallace has supplied them to many of the principal universities of this country and to the Government. The great electromagnets at Stevens Institute of Technology, at Hoboken, N. J., and at West Point Military Academy, made by him, are able to support weights of 5,000 pounds and more.

XIV.

It is a fact well-known to many of the readers of THE ELECTRICAL ENGINEER that a number of very important patents taken out by inventors in this country which have led to expensive litigation and claims of priority by various inventors, have been given their quietus through the discovery that these inventions were anticipated by the work of William Wallace and his assistants. A notable instance is the arc lamp clutch mechanism claimed by Mr. Chas. F. Brush, found to have been first used in the Wallace lamp at the suggestion of Mr. Leroy White of Waterbury; and the claim of Mr. Edison covering the controlling of the output of a dynamo by the putting-in and cutting-out of coils in the field circuit was found to have been applied to an early Wallace dynamo used, I believe, for plating purposes. It is interesting furthermore, to speculate on the effect which would have been produced upon the electric lighting industry had Wallace patented his arrangement of arc lamps in series. Certainly the fame and finances of this most deserving pioneer in the electrical field would have been greatly enhanced thereby.



WALLACE'S EXPERIMENTAL APPARATUS.

In conclusion the writer would state that Mr. Wallace is a member of the Institute of Electrical Engineers, of the American Society of Mechanical Engineers, of the Society of Civil Engineers, the Association for the Advancement of Science, and many other scientific organizations.

THE THEORY OF SUBMARINE CABLE LAYING.—II.

BY

GWLittlehales.

(Concluded.)

The following table gives the value of the holding power to be applied to the brake for depths of the sea increasing from 440 to 2,660 fathoms and for speeds ranging from 2 to 10 knots per hour, the constants of the cable being the same as those used in forming the preceding table:

Depth in fathoms.	Hold, *f*, to be applied to the brake for velocities of the ship per hour of					*ph*.
	2 Knots.	4 Knots.	6 Knots.	8 Knots.	10 Knots.	
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
440	919.6	874.8	802.7	701.9	572.4	1007.9
890	1839.2	1749.6	1605.4	1403.9	1144.8	2015.9
1330	2758.9	2624.4	2408.1	2105.8	1717.1	3023.9
1780	3678.4	3498.9	3210.8	2807.8	2289.5	4031.6
2220	4597.9	4373.9	4013.5	3509.7	2861.8	5039.8
2660	5517.7	5248.5	4816.2	4211.7	3434.4	6047.5

The angle β, which determines the effective motion of each element of the cable, is easily calculated by the relation

$$\tan\beta = \frac{\mathrm{ED}}{\mathrm{EC}} = \frac{v\sin\alpha}{v\sin\alpha\tan\frac{\alpha}{2} + mv} = \frac{1}{\tan\frac{\alpha}{2} + \frac{m}{\sin\alpha}};$$

or, substituting in the denominator, its value as derived from equation (8),

$$\tan\beta = \frac{v}{t}\ \frac{ph}{ph - f} \qquad (12).$$

From equation (8),

$$m = \frac{ph - f}{\frac{v}{t}\,ph}\sin\alpha - \tan\frac{\alpha}{2}\sin\alpha$$

$$= \frac{t\,(ph - f)}{vph}\sin\alpha - 2\sin^2\frac{\alpha}{2} \qquad (13)$$

$$= \cot\beta\sin\alpha - 2\sin^2\frac{a}{2}.$$

The angle of immersion, α, being generally small, as soon as the speed of the ship becomes considerable, $\sqrt{\cos\alpha}$ can be neglected in equation (7), and the following relation may be written to serve for practical use:

$$\tan\alpha = \frac{u}{v}.$$

To show that the error so introduced may be neglected, the angle α is here calculated from each of the formulas for the kind of cable already considered and for speeds of the ship ranging from 2 to 10 knots.

α	Speed of Ship.				
	2 kn.	4 kn.	6 kn.	8 kn.	10 kn.
Calculated from equation (7)...	51°-50′	28°-05′	18°-55′	14°-15′	11°-25′
Calculated from equation (14)..	45°-00′	26°-34′	18°-26′	14°-02′	11°-19′

From this table it appears that as soon as the ship acquires a speed of 6 knots per hour, which is about the average speed of ships while engaged in cable laying, the values of the angle α calculated from equations (7) and (14) are so near alike that in practice (14) may be substituted for (7).

If the trigonometric functions of α be now expressed according to equation (14), neglecting terms containing the factor $\frac{u}{v}$ raised to powers higher than the second, we shall have

$$\sin \alpha = \frac{u}{v}, \qquad \tan \frac{\alpha}{2} = \frac{u}{2\,v}, \qquad \sin \frac{}{2} = \frac{u}{2\,v}.$$

Substituting these values in equations (8), (11), and (13), they become :

$$f = ph\left(1 - \frac{u}{2\,t} - m\,\frac{v^2}{u\,t}\right) \tag{15}$$

$$P = ph\left(1 - \frac{u}{2\,t}\right) \tag{16}$$

$$m = \left(\frac{ph - f}{ph} \times \frac{u\,t}{v^2}\right) - \frac{1}{2}\,\frac{u^2}{v^2} \tag{17}$$

We see by the last of these equations that the slack of the cable is inversely proportional to the square of the velocity of the ship. The first two terms of the second member of this equation being much greater than the other; we see, moreover, that the slack depends above all on $ph - f$, that is to say, upon the difference of the weight of the length of the cable which may be suspended vertically in the water from the ship to the bottom of the ocean and the retaining force exercised by the brake. Therefore, the slack may be changed either by acting on the brake or by altering the speed of the ship.

To investigate the effect upon the slack of changes in the retaining force of the brake, in the speed of the ship, and in the depths of the ocean where the cable is laid, let us differentiate m in equation (17) with reference to f, v, and h successively:

$$\frac{d\,m}{d\,f} = -\,\frac{u\,t}{ph\,v^2}$$

$$\frac{d\,m}{d\,v} = \left(u\,t - \frac{f\,u\,t}{ph} - \frac{u^2}{2}\right) \times -\,\frac{2}{v^3} = -\,\frac{2\;m}{v};$$

$$\frac{d\,m}{d\,h} = \frac{f\,u\,t}{p\,v^2} \cdot \frac{1}{h^2} = \frac{f\,u\,t}{p\,v^2\,h^2}$$

Whence

$$d\,m_f = -\,\frac{d\,f}{f} \cdot \frac{f\,u\,t}{p\,h\,v^2} \tag{18}$$

$$d\,m_v = -\,\frac{d\,v}{v}\,2\,m \tag{19}$$

$$d\,m_h = \frac{d\,h}{h}\;\frac{f\,u\,t}{p\,h\,v^2}. \tag{20}$$

It is to be remarked that, as the second member of equation (19) is independent of the constants of the cable and of the depth of the ocean, the first member depends only on the variable velocity of the ship. For instance, if the velocity of the ship were increased by 5 per cent., the slack would be diminished by $\frac{1}{10}$ of its value and would fall to nine per cent. if it had before been 10 per cent.

Again, as the same expression, $\frac{f\,u\,t}{p\,h\,v^2}$, is found as a factor in the second members of (18) and (20), the slack will vary by equal amounts but in opposite directions for the same proportional changes in the retaining force of the brake and in the depth of the ocean. Referring again to the cable whose constants are $p = 0.336$ pounds to the foot, $t = 22.96$ feet per second, and $u = 3.28$ feet per second, and supposing the cable to be laid in a depth of 1,780 fathoms with 10 per cent. of slack and at a speed of 6 knots an hour, we shall find by equation (15) that the retaining force of the brake must be 3,280 pounds.

Under these conditions equations (18) and (20) give

$$d\,m = -\,0.62\,\frac{d\,f}{f} \text{ and } d\,m = 0.62\,\frac{d\,h}{\mathrm{h}}.$$

If the depth increases five per cent., say 90 fathoms, the slack will be increased by $\frac{31}{100}$ of its previous value or will rise from 10 per cent. to $13\frac{1}{10}$ per cent. To keep it at 10 per cent., it will be sufficient to increase the retaining force of the brake in the same proportion as the depth has increased, that is to say, five per cent. or 164 pounds. Moreover, changes in the depth and in the brake-power vary the amount of slack in a more rapid proportion than changes in the velocity of the ship, and it is found preferable in practice to control the amount of slack by acting on the brake.

If a cable were laid without any brake, we would have for the slack, by putting $f = 0$ in equation (15),

$$m = \frac{1}{2}\,\frac{u\,(2\,t - u)}{v^2}.$$

With $u = 3.28$ feet per second, $t = 22.96$ feet per second, and $v = 6$ knots per hour, m would become equal to 72 per cent. To maintain it at 10 per cent., the velocity of the ship would have to be increased in such a way that

$$v = \sqrt{\frac{u\,(2\,t - u)}{2 \times \frac{1}{10}}},$$

which would lead to the almost impracticable speed of 16 knots per hour. But by changing the constants of the cable, and making $u = 1.64$ feet per second, $t = 13.12$ feet per second, and $m = 10$ per cent., the speed of the ship would be about $8\frac{1}{2}$ knots per hour which is easily maintained.

LAMINATED OR DIVIDED IRON AND OTHER METALLIC MASSES IN ELECTROMAGNETIC APPARATUS—VIII.

BY

Thos D Lockwood

(Concluded.)

SUPPLEMENTARY NOTE ON PARASITIC CURRENTS.

Since the main object of laminating or otherwise dividing cores and other metallic masses exposed to induction, is to break up circuits, within which parasitic induced currents might circulate and waste energy, a supplementary note on such currents does not appear out of place.

Until a comparatively recent date, these were by many persons, (albeit quite erroneously) termed Foucault-currents. In the early days of electromagnetism the experiments made by the different investigators were so interlaced and interlocked, that it is difficult to tell where or with whom special phenomena, afterwards elucidated, did in fact originate. It is for example now quite evident that the so-called "magnetism by rotation" of Arago was simply an instance of magneto-electric induction.

If the parasitic currents, alias "eddy-currents", alias "Foucault-currents" should bear the name of any one, it would appear that an association with that of Arago is the most appropriate.

It was in 1824 that Arago, studying the oscillations of a magnetic needle, first ascertained that when such a needle was caused to oscillate above non-ferruginous conducting surfaces, it began, when left to itself, to oscillate in arcs of continuously decreasing amplitude, as if it had been placed in a resisting or viscous medium; and it was further observed that the diminution in the length of swing did not alter the number of oscillations that were performed in a given time, and that it varied with the distance between the needle and the surfaces.

For this discovery, the Royal Society of London awarded Arago its Copley medal, and he has the honor of being the first foreigner receiving this award. His experiments led him to believe that the needle would be dragged along by rotating the metal plates which had the power of diminishing the amplitude of its oscillations, and upon trying the experiment this conjecture was shown to be correct. This discovery closely followed the former and analogous one. A plate of pure copper was caused to revolve by clockwork which also was of copper, under a magnetic needle within a glass receiver, and with a sheet of paper between the needle and the revolving plate to prevent air currents. Gradually the needle was drawn from the magnetic meridian, till finally on a very rapid rotation, it fairly swung round and continued in constant rotation.

Arago also noticed (and here we have rudimentary lamination) that when the plates had portions cut out in the direction of the radii, their action on the needle was diminished. An account of these experiments was read before the Academy of Sciences, March 7, 1825.

Barlow (*Phil. Trans.*, 1825), Herschell, Seebeck (*Pogg. Ann.*, 1826), Babbage (*Phil. Trans.*, 1825), and Harris (*Phil. Trans.*, 1831), made elaborate researches on the subject, and it is noteworthy that both Babbage and Herschell also found that the number of revolutions performed by the disc in a given time was greatly affected by cutting the plate through in the direction of the radii, the accelerating forces diminishing with the number of slits made; ("Treatise on Electricity," De La Rive, Vol. i., 1853, p. 351).

Poisson (Mém. de l'Acad., vii., 1826), attempted in his memoir on magnetism to give a theoretical explanation of the phenomena, but it was reserved for Faraday to point out the true explanation, for, as we now know, Arago produced true magneto-electric currents, although he knew it not. Faraday's considerations on the phenomena, together with a full account of the experiments by means of which he in 1831, reached the conclusion that Arago's rotations were the results of the development of magneto-electric currents, are all detailed in the "Experimental Researches" (Series i., §§. 80 to 139, Vol. i., pp. 24–41); beginning by the statement that induction "appears capable of explaining fully the remarkable phenomena observed by M. Arago between metals and magnets when either are moving, as well as most of the results obtained by Sir John Herschell, Messrs. Babbage, Harris and others;" and discussing the action of the rudimentary laminations of Arago, Babbage and Herschell, in § 127.

Some years later, Plücker suspended a cube of copper between the poles of a powerful electromagnet and setting it spinning about a vertical axis, found that it stopped dead the moment the magnet was excited.

It was not, however, until September 1855, that Leon Foucault made the experiment which, though sufficiently interesting, was quite inadequate in view of what had gone before, to warrant the attachment of his name to parasitic magneto-electric currents. He arranged a flat copper disc between the flat poles of an electromagnet placed at such a distance apart as just to admit it between them. The disc was set in motion by means of a suitable driving gear. So long as the magnet was not excited, the driver had comparatively little work to do; but as soon as the magnet was excited the work required to keep up any considerable velocity greatly increased. The additional work thus expended appears in the heat developed in the disc by the induced currents.

Foucault's real discovery then, was that the force required for the rotation of a copper disc moving in its own plane becomes greater, the disc at the same time growing hotter, when the disc is made to rotate with its rim between the poles of a horseshoe magnet; and his account of it is recorded in the *Comptes Rendus* of that year.

The only further experimental investigations of this subject, of which I am informed, are those of Nobili and Matteucci which are to be found in *Wiedemann*, Bd. 2, § 860, etc.; and as for its theoretical treatment the reader is referred to *Crelle's Journal*, 1864; and *Pogg. Ann*, 1864, where Jochmann's mathematical theory is stated; and to Maxwell's complete and masterly theory of the induction of currents in a plane conducting sheet, reached by means of a most elegant application of the method of images; *Proc.* R. S., 1872; "Electricity and Magnetism," vol. 2, §§ 668, 669.

INFLUENCE OF FREQUENCY ON THE WORKING OF ALTERNATE CURRENT TRANSFORMERS.—I.

BY

Chas. Steinmetz.

Taking into consideration the number of turns and the resistances of primary and of secondary circuit, from the dimensions of the magnetic circuit, its characteristic and coefficient of hysteresis, the behavior of the alternating current transformer under the various conditions of load and of frequency can be calculated with a high degree of exactness, as is well known. To determine, however, how far calculation agrees with observed results, and whether Foucault currents, etc., play an important part, and especially, whether such a thing as *viscous hysteresis* exists—which, as is known, in calculations is assumed as non-existent, but which, if present, would introduce a serious error into the calculations,—I undertook some time ago a number of tests with a small Westinghouse transformer (voltmeter converter) of about 500 watts output, with largely varying frequencies, of 36.3, 137.5 and 204.5 complete periods per second.

Since the amount of stray magnetism, or magnetic leakage between primary and secondary coil, was of no importance for the object of this research,—it being understood that by proper arrangement of primary and secondary winding the stray magnetism can be reduced to practically nil,—and since the hysteretic loss has been proved to be independent of the load, and only dependent on the magnetization, it was sufficient to make only open circuit tests, and therefrom to calculate, by means of the known resistances, the conditions for working under load.

The alternating current was derived in the high frequency tests (137.5 and 204.5 periods) from a 1 h. p. 50-volt Westinghouse dynamo, which was varied in E. M. F. by varying the exciting current, and driven by a continuous current motor. In the low frequency tests (36.3 periods) the alternating current was derived from a continuous current Eickemeyer motor, which by means of two sliding rings was converted into a bipolar alternator.

The transformer was an old Westinghouse voltmeter converter of the following description:—Primary circuit: 900 turns No. 25 B. & S. gauge, 52 ohms resistance. Secondary circuit: Two coils of 45 turns No. 14 B. & S. gauge, of .21 ohm resistance each. One of these coarse wire coils was used for the excitation, and fed by the alternator.

The dimensions of the magnetic circuit were:—Average cross-section, 40 cm.^{2} Average length, 22 cm. Thickness of iron plates, about .03 cm.

The method of determination was the usual three-electro-dynamometer method, with long shunt, that is: Ammeter and coarse wire coil of wattmeter were connected in series to the transformer coil, voltmeter and fine wire coil of wattmeter in long shunt around transformer and instruments, so that in determining the voltage at the transformer terminals correction had to be made for the E. M. F. consumed by ammeter and coarse coil of watt-meter; and in determining the iron loss of the transformer the wattmeter readings had to be reduced by the power consumed by the resistance of transformer coil and instruments, which correction, however, was only small, except for the highest readings with 36.3 periods, in which readings, owing to magnetic saturation, the current and consequently the resistance loss were very large and even larger than the iron loss, so that the exactness of these higher readings is somewhat impaired by the uncertainty of the resistance due to the high temperature coefficient of copper, a defect which is incident to this method, as explained elsewhere.[1]

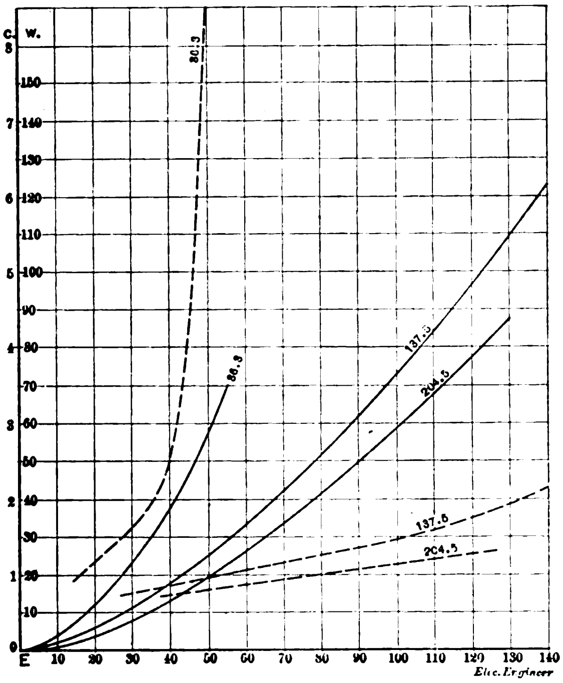


FIG. 1.

The results of these tests were plotted in curves, and are given in Fig. 1. As abscissæ there are used the E. M. F.'s in effective volts at the terminals of the coarse wire coil of the transformer (of 45 turns) which was fed by the alternator. As ordinates are given in drawn lines, the losses in the iron of the transformer (hysteresis and probably eddy-currents), in watts, for 36.3, 137.5 and 204.5 periods per second. As dotted curves are given the magnetizing currents, corresponding to the different frequencies and E. M. F.'s, in amperes effective. Multiplied by 45, the number of turns of the excited transformer coils, these magnetizing currents give the M. M. F's in ampere turns effective.

As seen from Fig. 1, the loss in the iron, corresponding to a given E. M. F., is the larger, the lower the frequency is, and the magnetizing current or "leakage current" (current on open secondary) is larger for slower frequencies, and increases, for a given frequency, with increasing E. M. F.; but slower than the E. M. F. increases, up to a certain point, where the current curve turns around abruptly and rapidly increases, quite out of proportion.

If the fine wire coil is used as primary, the "leakage" or magnetizing current will be 20 times smaller. Hence, for instance, at a frequency of 204.5 the magnetizing current at 50 volts secondary is .040 ampere primary, or .80 amperes secondary; at 100 volts secondary, it is only .056 ampere primary or 1.12 ampere secondary; while with a frequency of 36.3, the magnetizing current is: At 27 volts secondary, 1.5 ampere secondary, or .075 ampere primary; at 54 volts secondary, 24 amperes secondary, or 1.2 ampere primary. So that in the first case, doubling the E. M. F. increases the current only 40 per cent. In the second case, doubling the E. M. F. increases the current by not less than 1,500 per cent., saturation being reached.

A SIMPLE SYSTEM FOR OPERATING ELECTRIC CLOCKS.

BY

R. G. Brown

How many of us have made an electric clock, a clock to be actuated by a small battery controlled by a central or primary clock,—made them to have in operation at our homes as a novelty, to show to our friends, and yet, how many such clocks are to be relied upon for correct time?

It would seem, at first thought, an easy problem to arrange a small device attached to an ordinary clock that would open and close once each minute an electric circuit, and yet, in practice to accomplish this result in a reliable manner with an ordinary cheap movement, has puzzled many.

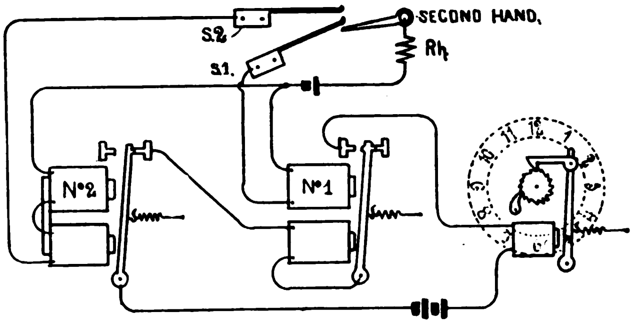
With a clock beating seconds the problem is comparatively easy, but such a clock requires a pendulum 32 inches in length, and is an expensive affair possessed by few. All cheap clocks make, on an average, 240 beats per minute and this is the cause of the trouble, for the reason that the second hand, moving so short a distance at each of the 240 beats, it is almost impossible to adjust a spring in such manner that the second hand will halt just before reaching the spring, and at the next beat move in contact with it, and again at the next beat move free from it. It must also be borne in mind that very little work can be put upon this second hand.

The system to be here described has been in use by the writer for some time past and can be depended upon for reliability. Its action is a decided open and shut, with the result that the secondary or electric clock cannot "jump" ahead or lag behind.

Briefly, it consists of a Seth Thomas No. 2 movement (costing $1.50 complete), two ordinary pony relays and three cells of Leclanché battery.

This clock has a second hand, in the path of which are arranged two light flat springs. The spools of the No. 1 relay are separated so as to be connected in independent circuits. Referring to the accompanying diagram, the operation is as follows: As the second hand comes in contact with the first spring—s1, the No. 1 relay armature is drawn against its front stop, thereby closing a circuit in which is included one of its own magnets, armature and back stop of the No. 2 relay, electric clock and two cells of battery

It may here be remarked that this circuit is not closed until the armature has actually reached its front stop and that after having reached there it is held in this position by one of its own magnets, and quite independent of the circuit closed by the primary clock; so that, however uncertain this latter contact may have been made or broken, there can be no false make or break in the circuit containing the electric clock.



BROWN SYSTEM OF ELECTRIC CLOCKS.

As the second hand of the primary clock leaves the No.

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[1] On the Law of Hysteresis.—II." *Transactions Am. Inst. Elec. Eng.*, Sept., 1892.

1 contact, this No. 1 relay still remains closed and will so remain until the hand comes in contact with the spring s2, thereby closing the No. 2 relay, whose armature, being drawn away from its back stop, opens the electric clock circuit, thereby causing the No. 1 relay armature to fall back on its insulated stop, thus leaving the electric clock and battery on open circuit until the second hand has made a complete revolution, when the whole operation will be repeated.

The two springs, s1 and s2, are arranged rather close together, with the result that the whole operation is completed in less than two seconds ; consequently during each minute we find the batteries are closed through resistances during 2 seconds, and are on open circuit the remaining 58 seconds. The Leclanché battery will work perfectly for a long time under these conditions.

The relays used by the writer have a resistance of 20 ohms each, and a small resistance of about 20 ohms is put in circuit with them, as shown. In the clock circuit proper, this is not necessary, as the circuit is closed barely a second per minute.

ON DISTRIBUTION OF POTENTIAL.

BY

George P. Huhn.

The following is a short and direct method of obtaining a sine curve, whose ordinates shall show the distribution of potential around the commutator, when we have plotted the integral curve and v. v.

The expression for the integral curve is

$$\int_0^{\alpha} \sin \theta \, d\,\theta = 1 - \cos \alpha.$$

The expression for the sine curve is $x = \sin \alpha$. Then if we call any ordinate of the integral curve a, and any ordinate in the sine curve x we have:

$$a : x :: 1 - \cos \alpha : \sin \alpha ; \ \frac{\sin \alpha}{1 - \cos \alpha}\, a = x.$$

Let us introduce into our formula a constant quantity k and we will have :

$$\frac{\sin \alpha}{1 - \cos \alpha}\, a\, k = x.$$

k, being a constant, affects only the absolute, not the relative values of the ordinates in the sine curve. For convenience I leave $1 - \cos \alpha$ in this form rather than writing vers α.

The average sine between 0 and 90° is $\frac{2}{\pi}$ (see Kapp) and is obtained as follows.

$$\frac{\int_{0^\circ}^{90^\circ} \sin \theta \, d\,\theta}{\theta} = \frac{1}{\frac{1}{2}\pi} = \frac{2}{\pi}.$$

Let Fig. 1 be any integral curve as plotted from our readings and let Fig. 2 be the sine curve derived from it by the formula

$$\frac{\sin \alpha}{1 - \cos \alpha}\, a\, k = x.$$

To find the value of k we proceed as follows :

The ordinate a'' (Fig. 1) represents the sum of the E. M. F.'s induced in all the commutator bars, n in number, which lie between 0 and 90°. If our plotted curve were an ideal integral curve the E. M. F. in any one bar would be proportional to the sine of the angle through which that bar had turned.

The average sine between 0 and 90° is $\frac{2}{\pi}$ and if all the commutator bars had been at this point the sum of the E. M. F's would have been the same. Therefore, dividing the total E. M. F. at 90° by n we will have $\frac{a''}{n}$ = E. M. F. induced in one bar at $\sin^{-1} \frac{2}{\pi}$ for an ideal integral curve with a'' as the ordinate at 90°.

But in our sine curve (derived from this ideal integral curve) we wish to have $x' = \frac{a''}{n}$, in order that each ordinate in the sine curve may show the E. M. F. induced in one bar at that angle. But this will be accomplished if we make the ordinate at 90° equal to $\frac{a''}{n} \cdot \frac{\pi}{2}$. And since our ideal curve is so drawn that the ordinate at 90° is equal to the ordinate at 90° in our plotted curve, we may, in our plotted curve, make

$$x'' = \frac{a''}{n} \cdot \frac{\pi}{2}.$$

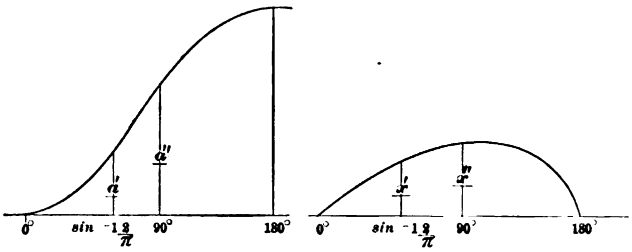
Substituting in the formula we have :

$$\frac{\sin \alpha^{90^\circ}}{1 - \cos \alpha^{90^\circ}}\, a^{90^\circ}\, k = x'' = \frac{a''}{n} \cdot \frac{\pi}{2}.$$

$$\therefore a^{90^\circ} k = \frac{a''}{n} \cdot \frac{\pi}{2} ; \ k = \frac{\pi}{2\,n}.$$

And since k is constant for all values of α and a, we have the formula :

$$\frac{\sin \alpha}{1 - \cos \alpha}\, a.\, \frac{\pi}{2\,n} = x ;$$



FIGS. 1 AND 2.

in which x is the absolute value of the E. M. F. induced in one bar at its angle.

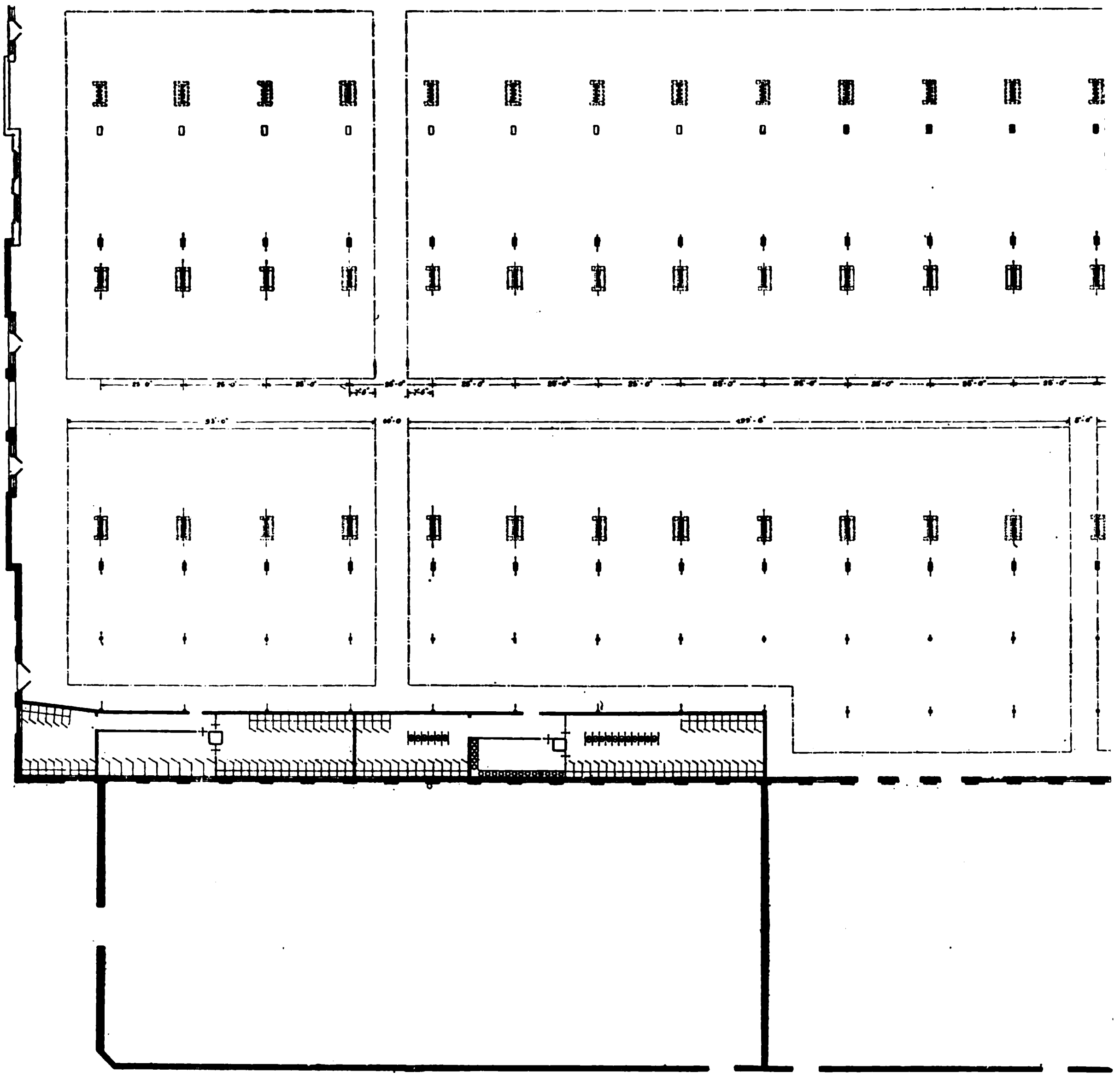
V. V. Having the sine curve plotted, we may find the integral curve by writing the above formula

$$a = x.\, \frac{1 - \cos \alpha}{\sin \alpha} \cdot \frac{2\,n}{\pi}.$$

"COMPLETE REPORTS AND COMMENTS."

The February 2 number of *Metal* constains the following in regard to the present "celebrated case" and, incidentally, the ENGINEER :

"Nearly every business man to-day, especially in the large cities, uses the electric light, and anything pertaining to this important means of illumination will be of interest. The latest developments in the incandescent lamp litigation shows a new claimant for priority to the invention in the person of Henry Goebel, a resident of New York, who has made affidavits and shown lamps on this principle, made in 1859, long before Edison ever thought of such a thing as an electric light. Our able contemporary, THE ELECTRICAL ENGINEER, has shown a deal of enterprise in giving a full and detailed statement of the proceedings in Boston, and supplements this with a fully illustrated article on the life and inventions of Goebel in this line. We congratulate THE ELECTRICAL ENGINEER on its keen insight in filling the demand of its readers by giving, in advance of the other electrical publications, such complete reports and comments."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Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
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SHALL WE STORE CURRENT OR CALORIC?

ELECTRICAL engineers have scarcely had time to test to a finality the value of storage batteries in central station work when they have already brought to their attention another method of storage which, if not designed to accomplish exactly the same purpose, is at least brought forward as a possible substitute. We refer to the scheme for heat storage due to Mr. Druitt Halpin, to which Prof. W. C. Unwin has recently drawn attention in a lecture before the Society of Arts. Based upon the consideration that even in the best managed electric central stations, the full consumption, due to fluctuations in load, is double that required to do the work at full load, Mr. Halpin was persuaded that the larger part of the waste was to be traced to the irregular action of the boilers, and that if the latter could be worked continuously and uniformly and the heat in excess of that required at any one time stored to be drawn upon when needed, this waste could be prevented. For this purpose he proposes a system in which for each pound of steam used, 16 pounds of water is heated to 406 degrees at an absolute pressure of 265 pounds per square inch, the water at the end of the operation being at a temperature of 367 degrees ready to be heated to 406 degrees again. The heated water is stored in a tank which is in free communication with the boiler; but instead of keeping the water level in the boilers constant, as usual, the water level in the storage tanks is kept constant, the boiler being filled with water. As steam is required it is taken from the storage tanks and the water thus consequently falls in temperature; from the storage tanks the cooled water, together with the feed, is constantly sent back to the boiler, the steam being taken from the storage tanks through a reducing valve. In order to show how his system would operate in practice, Mr. Halpin takes the case of the Kensington (London) electric light station. The total area of the load line is 15,600 effective horse power hour. The station could be worked, therefore, by engines and boilers working at 650 h. p. Under present conditions, without storage, engines working to over 2,000 h. p. were required during the short period of maximum load. In place of boilers with a capacity of 2,000 h. p. worked on an average at only one-third their capacity, Mr. Halpin would put in boilers to supply a mean demand of 650 h. p., and work them continuously during 24 hours, thus avoiding all the waste due to intermittent working. In estimating the cost of his system for the case under discussion Mr. Halpin states that working the station *without* storage tanks 10 boilers are required at a cost of £10,300, whereas he calculates that with his storage tanks three boilers and 24 tanks would be required which together would cost £15,000. Although the latter figure is £5,000 in excess of the former, Prof. Unwin points out that if in consequence of continuous working only one-half pound of coal per horse power per hour was saved, then the coal saved would be 1,270 tons, the value of which was very good interest on the extra £5,000 spent on the plant.

Without going into the difficulties which Prof. Unwin pointed out might arise when this system is applied on a large scale, but which could probably be overcome after some practical experience with it, there are other considerations which ought to be taken into account in a comprehensive survey of the system. Mr. Halpin, it will be noted, bases his calculations largely on the saving at the boiler. Now, while this may be justified to some extent the fact remains that probably, after all, the largest part of the loss in central stations occurs in the cylinders of the engines, and this, of course, the proposed system does not take into consideration. We think it would be difficult to prove that the intermittently-worked boiler is anywhere nearly so wasteful of heat as the underloaded engine, and as this is the almost normal condition of central station working, the system proposed by Mr. Halpin touches only a secondary part of the evil which it is desired to overcome.

It is at this very point that the storage battery comes in as a saving factor by permitting the engines to work at full load continuously; and in doing so it also keeps the boilers at their full activity. Without wishing in any way to detract from the ingenuity of Mr. Halpin's system, we must reserve favorable judgment until more substantial demonstrations are submitted.

THE GOEBEL DEFENCE REJECTED.

WE print elsewhere in this issue the decision of Judge Colt granting an injunction against the Beacon Vacuum Pump and Electrical Company in the suit for infringement of the Edison lamp patent. The weakest point in the defendant's case, was the insufficiency of proof as to the actual existence or use of the particular lamp designated as "No. 4" at a date prior to the date of Edison's invention. From the language of the opinion, it seems pretty clear that if it had been possible to establish beyond peradventure, the truth of the assertions made by Goebel and his son, as to this exhibit, it might in itself have been quite sufficient to overthrow the patent. It is possible, though not probable, that the missing link in the evidence may yet be found, and the truth of the defendant's contention thereby established; but unless some such event should occur, there would seem to be no probability that the decision of Judge Colt will be set aside. We are assured that the defendants will continue their fight, which, they say, is only just begun.

Telephone Litigation.

THE Government suit for the repeal of the Berliner telephone transmitter patent promises to be scarcely less interesting in electrical circles than the incandescent lamp litigation now in progress. In other columns we give some further information as to the nature of the allegations made in the bill of the Department of Justice.

Western Union.

IF there be any virtue in long years of faithful and brilliant service, immense executive ability, an intelligent comprehension of the needs of the system, and the ready loyalty of a host of old friends and subordinates, Gen. Thomas T. Eckert is the next and third President of the Western Union Telegraph Company.

LEGAL NOTES.

INCANDESCENT LAMP LITIGATION.

AN INJUNCTION GRANTED AGAINST THE BEACON VACUUM PUMP AND ELECTRICAL CO.—THE GOEBEL CLAIMS REJECTED.

CIRCUIT COURT OF THE UNITED STATES—DISTRICT OF MASSACHUSETTS.

In Equity.

No. 3096.
EDISON ELECTRIC LIGHT COMPANY,
vs.
BEACON VACUUM PUMP AND ELECTRICAL COMPANY, *et al.*

OPINION OF THE COURT.

[FEB. 18, 1893.]

COLT, *J.* In May, 1885, the plaintiff brought suit in the United States Circuit Court for the Southern District of New York against the United States Electric Lighting Company for infringement of the patent now in controversy, which was granted to Thomas A. Edison, January, 27, 1880, for an improvement in electric lamps; and on July 23, 1891, a decree was entered, adjudging the validity of the patent and ordering an injunction and account. Upon appeal to the Circuit Court of Appeals for the Second Circuit, the decree was affirmed in October, 1892. Another suit was then brought in the same court against the Sawyer-Man Electric Company, and a preliminary injunction was granted *pro forma* until a decision could be had by the Circuit Court of Appeals, which on December 19, 1892, affirmed the order, and directed an injunction. Suits were then immediately brought against the Westinghouse Electric Company in Pennsylvania, The Perkins Electric Lamp Company, and the Mather Electric Company in Connecticut, and preliminary injunctions obtained.

The present bill was filed January 10, 1893, and the plaintiff now moves for a preliminary injunction against the defendants, based upon the foregoing prior adjudications. This motion is resisted on the ground of newly discovered evidence bearing on the question of novelty of the Edison invention, which was not before the Courts in the other cases. As to these other cases, it is said that there has been but one final adjudication upon the merits, which was in the suit against the United States Electric Lighting Company, that the defendants in the other prior suits were so connected with that Company, that they were in privity with it, and that therefore injunctions were granted as a matter of course.

The suit against the United States Company was thoroughly and obstinately contested, as is shown by the record, which covers about six thousand printed pages. The general rule is that where the validity of a patent has been sustained by prior adjudication, and especially after a long, arduous and expensive litigation, the only question open on motion for a preliminary injunction in a subsequent suit against another defendant, is the question of infringement, the consideration of other defences being postponed until final hearing. *Brush Electric Company* v. *Accumulator Company*, 50 Fed. Rep. 833; *Robertson* v. *Hill*, 6 Fisher, 465, *Cary* v. *Domestic Company*. 27 Fed. Rep. 299; *Coburn* v. *Clark*, 15 Fed. Rep. 804; *Mallory Manufacturing Company* v. *Hickok*, 20 Fed. Rep. 116; *Green* v. *French*, 4 Ban & Ard. 169; *Blanchard* v. *Reeves*, 1 Fisher, 103; *Goodyear* v. *Rust*, 6 Blatch. 229; *Cary* v. *Lovell Manufacturing Company*, 24 Fed. Rep. 141: *Sargent Manufacturing Company* v. *Woodruff*, 5 Bis. 444; *Kirby Bung Manufacturing Company* v. *White*, 1 McCrary, 155; *Putnam* v. *Keystone Bottle Stopper Company*, 38 Fed. Rep. 234; *Consolidated Bunging Apparatus Company* v. *Peter Schoenhofen Brewing Conpany*, 28 Fed. Rep. 428; *Newall* v. *Wilson*, 2 De Gex, M. & G. 282; *Davenport* v. *Jepson*, 4 *De* Gex, F. & J. 440; *Boville* v. *Goodier*, 35 Beav. 427.

The only exception to this general rule seems to be where the new evidence is of such a conclusive character, that if it had been introduced in the former case, it probably would have led to a different conclusion. The burden is on the defendant to establish this, and every reasonable doubt must be resolved against him; *Ladd* v. *Cameron*, 25 Fed. Rep. 37; *Cantrell* v. *Wallick*, 117 U. S. 689; *Winans* v. *Eaton*, 1 Fisher, 181; *Bailey Wringing Machine Company* v. *Adams*, 3 Ban & Ard. 96; *Norton Door Check & Spring Company* v. *Hall*, 36 Fed. Rep. 691; *Lockwood* v. *Faber*, 27 Fed. Rep. 63; *Glaenzer* v. *Wiederer*, 33 Fed. Rep. 503; *Cary* v. *Domestic Spring Bed Company*, 26 Fed. Rep. 38.

There is no denial of infringement in the present case under the construction given to the patent in prior adjudications. The contention of the defendants is, that this motion should be denied on the ground that they have recently discovered that Henry Goebel, a German watchmaker, living in New York, invented the Edison incandescent lamp as early as 1854, and that, therefore, the Edison patent is void for want of novelty, or, at least, must be limited to the coiled form of filament. This is the same line of attack upon the patent which was unsuccessfully made in the case against the United States Electric Company. It was there urged that the Starr lamp of 1845, the Roberts lamp of 1852, the Lodyguine, Konn, and other lamps which appeared between 1872 and 1876, the Bouliguine lamp of 1877, the Sawyer and Man lamp of 1878, and the Edison platinum lamp of 1879 limited the Edison patent to narrow inventions or rendered it void for want of patentable novelty. But the Court, with a most exhaustive review of the prior art before it, refused to take this view and held that the second claim of the patent, read with the specification, covered a broad and fundamental invention, namely, an incandescent lamp, composed of a carbon filament hermetically sealed in an all glass chamber exhausted to a practically perfect vacuum, and having leading-in wires of platinum. Judge Wallace, in his opinion in the Circuit Court, says: Read by those having this knowlege, the radically new discovery disclosed by the specification is that a carbon as attenuated before carbonization as a linen or cotton thread, or a wire seven one thousandths of an inch in diameter, and still more attenuated after carbonization, can be made which will have extremely high resistance and be absolutely stable when maintained in a practically perfect vacuum. It informs them of everything necessary to utilize this discovery and to incorporate it into a practical lamp. It describes, with the assistance of the recital in the second claim, as the vacuum in which the burner is to be maintained, a bulb made wholly of glass, exhausted of air, sealed at all points by the fusion of the glass, and in which platinum leading wires are sealed by the fusion of the glass. It describes the materials of which the burner is to be made and instructs them that the materials are to be shaped into their ultimate form before carbonization. It describes the use of platinum for the leading wires, and a method of securing the leading wires and filaments, intended to dispense with clamping, which consists in moulding tar putty about the joints, and carbonizing the whole in a closed chamber.

By this invention Edison disclosed to the world for the first time a practical, commercial incandescent lamp, adapted for domestic uses. The problem was by no means easy of solution.

To subdivide the electric light and embody it in a cheap and durable domestic lamp, capable of successfully competing with gas, had for years baffled the science and skill of the most eminent electricians in this country and in Europe. The difficulty lay in the practical construction of a durable incandescent lamp rather than in a knowledge of the elements which should compose such a structure. Carbon burners, platinum wires, exhausted glass receivers were old and well-known. As early as 1845, Starr suggested in the King patent a lamp composed of a thin pencil of carbon enclosed in a Torricellian vacuum, and Roberts, in 1852, proposed to cement the neck of the glass globe into a metallic cup and to provide it with a tube for exhaustion by means of a hand pump. Later, Lodyguine and others provided their lamps with several short carbon pencils which were successively brought into circuit as the pencils were consumed, also various devices for perfecting the joints between the metal base and the glass globe, while Sawyer and Man, in 1878, made the bottom plate of glass instead of metal, and charged the lamp with an atmosphere of nitrogen gas to avoid destruction of the burner from oxidation. In his 1879 lamp Edison used a platinum burner which proved a failure because the platinum melted near the point of incandescence. Mr. Schwendler, a noted English electrician, said in 1879, "unless we shall be fortunate enough to discover a conductor of electricity with a much higher melting point than platinum, and which at the same time does not combine at high temperature with oxygen, we can scarcely expect that the principle of incandescence will be made use of for practical illumination."

The arc lamp was known as early as 1844, but its great light made it unfit for use in dwellings. The question was how to divide the electric light for domestic purposes. Many scientists considered the problem as hardly within the range of possibility. From the results of the experiments of Fontaine, the French scientist, published in 1877, it would seem that almost insurmountable obstacles, founded on the operation of natural laws, stood in the way of the successful division of the electric light. Mr. Preece, the electrician for the British General Post Office, pronounced early in 1879 that "the division of the electric light is an absolute *ignis fatuus*."

Those who dissented from this view were Mr. Edison in this country and Mr. Lane-Fox in England, who both reached the conclusion that the sub-division of the electric light could be accomplished provided the radiating surface of the burner of the lamp was reduced in extent so that only a moderate volume of light would be emitted, while at the same time the resistance of the burner was increased so as to enable the employment of relatively small conductors for leading the electric current to the lamps; or, shortly stated, the burner should have a high ratio of resistance to radiating surface. Edison first embodied this discovery in his platinum lamp in 1879, but this lamp was unsatisfactory and the problem remained unsolved. While experimenting with the platinum lamp, Edison discovered that the passage of a current through the platinum during the process of exhausting the enclosing chamber would drive out occluded gases, and thereby raise the melting point of the burner. This led him to secure greater perfection in the vacuum by the employment of a highly exhausted glass chamber similar to those used by Crookes, made entirely of glass, and with all the joints closed by the fusion of the glass. After the failure of the platinum lamp, it occurred to Edison to substitute a short filament of carbon in place of the long platinum burner, into the nearly perfect vacuum chamber, and it was found that such filament was stable at high temperature and free from disintegration and oxidation. It was thus made known that the disintegration of the carbon burner was not caused by the electric current, but was due to "air washing," or the attrition produced by the passage of the air over the highly-heated surface of the carbon.

As late as 1878, Mr. Sawyer, in a patent to Sawyer and Man, stated that no incandescent lamp had yet been devised which was practically operative, because of the defective methods employed for charging the lamp with artificial atmosphere which resulted in the disintegration of the carbon; second, because it was impossible under varying degrees of heat and pressure to maintain perfect joints; third, because unequal expansion of the carbon and its holder had resulted in fractures of the burner. But Edison overcame these obstacles, and produced a practical lamp. When we review the literature which preceded this invention, the subtle force with which it had to deal, whose laws had to be intelligently investigated and understood, the well-nigh perfect workmanship necessary in construction, and the slow steps by which the end was finally reached, it seems on its face almost incredible that the incandescent lamp of Edison was in fact invented and operated by Henry Goebel in New York forty years ago, and publicly exhibited before hundreds of people.

Goebel's story runs thus: He came to this country from Germany in 1848. He was a watchmaker and optician by trade, and opened a shop on Monroe street in New York. While in Germany he received instruction in physics from Professor Munchhausen of Hanover, and assisted him in making experiments, such as obtaining light from electricity, and making galvanic batteries. Through this means he learned to make the arc lamp, and he believed that an incandescent lamp could be produced by a small continuous carbon enclosed in an exhausted glass tube hermetically sealed. He also became familiar with the use of the common air pump, the blow pipe, the method of producing the Torricellian vacuum, and the making of carbon conductors. He says he learned at this time that the co-efficient of the expansion of glass and platinum were the same. As soon as he obtained money enough from his regular business, he began experimenting with electricity in his shop in New York. Soon after his arrival he exhibited an arc lamp on the top of his house, which called out the fire engines and caused his arrest. He then turned his attention to incandescent lamps, and made a number of them. The first form of lamp he constructed was called a "fiddle-bow" or "meat-saw", and it consisted of an exhausted tube made of glass, in one piece, with leading-in wires sealed into the enclosing chamber by fusion of the glass. The wires with the carbon burner attached resembled in form a fiddle-bow.

The next style of lamp was called the "hairpin", from the shape of the carbon burner.

A third form of lamp was also made about this time, presenting the carbon and connecting wires in a straight line, but this proved unsatisfactory as the burner broke with the heat. The leading wires were sometimes made of platinum, but generally of iron or copper, which was less expensive. The carbons used were less than one-one hundreth of an inch in diameter, and were made from flax, reed, and black cane. The first lamps were exhausted by the common air-pump, but not getting a good vacuum they were subsequently exhausted by filling the tubes with mercury, inverting them, and allowing the mercury to run out, and then sealing them off. Before sealing, the incandescent conductor was heated slightly, which, together with a little shaking, made the mercury that stuck to the carbon fall off. The ends of the leading wires were flattened, then twisted into a spiral tube, into which the ends of the carbons were inserted, and the tubes were then compressed. The joints were generally cemented with heated stove polish, though sometimes the ends of the carbon were electro-plated with copper, and an amalgam of gold and mercury applied to the joints which adhered to the copper, and sometimes a platinum sponge was used for this purpose. The electric current was produced by chemical action from batteries. The first lamps were made from cologne bottles, but afterwards from glass tubes.

A large number of the fiddle-bow and hair-pin lamps were made while living on Monroe street, between 1850 and 1872, and there was no six months up to the year 1880 when a number was not made, and prior to 1879 more than a hundred were constructed. No secret was made of any part of their construction, and they were lighted and shown to whomever desired to see them, and there was no time until after 1880 when several of the lamps were not in his possession.

If the carbons did not burn up as soon as the current was turned on, the life of the lamp was almost indefinite, but it could not be run very long at a time because the battery would give out. These lamps were used upon a wagon carrying a telescope, which was taken to Union Square and Cooper Institute for exhibition. For looking through the telescope a small fee was charged, and the lamps were used partly for light and partly to attract attention. Many hundreds of people saw these lamps while so exhibited. Another lamp was arranged to illuminate the face of a clock which hung in his bed room, and this use was continued in his Grand street house.

After removing to 468 Grand street, which was in 1877, he made a mercury vacuum pump, the idea having been suggested by hearing of the Geissler pump. In using the old process to exhaust the lamps, particles of mercury adhered to the interior parts, and it was with considerable difficulty that these particles were got out. A patent was obtained on this pump January 24, 1882. In 1881, he was employed by the American Electric Light Company. He refused to leave his shop, but his son Adolph, now dead, worked for the Company at its factory. About this time Mr. Crosby, who was connected with the Company, called upon him several times and was much interested in his lamps, and engaged him to make carbons and exhaust lamps. Until he worked for the Company he never heard of Edison, or his incandescent lamp, or of a dynamo machine for electric lighting, and had never read anything on the subject in the public prints. He does not read English, but speaks and understands it fairly well.

The Goebel lamp, Exhibits 1, 2 and 3, he recognizes as his own manufacture, and says that these very lamps were made before gas was put into his house in Monroe street. These lamps are of the fiddle-bow form. He is positive they were made before gas was introduced into his house, because they are discolored by smoke from an oil lamp flame employed in the use of the blow pipe.

After arguments on the motion, Goebel filed a supplemental affidavit and produced another lamp known as Exhibit 4. This lamp has leading-in wires of platinum, and is of much superior workmanship and finish. He also produced several tools for making carbons, and describes their use. He declares that before 1872 he had arrived at a definite conclusion as to the best material for making carbons and had settled upon bamboo. He had also decided upon platinum as the best leading-in wire, and stove polish as the best material for cementing the joints. He says that lamp No. 4 has been in his possession since before moving from Monroe street in 1872, that he made it and burned it a good many times before and since, that he made other lamps both in Monroe and Grand streets with carbonized bamboo burner, platinum leading wire connections, and glass tube, similar to No. 4, but he doubts if in any other lamps the glass feature was as handsome as in this exhibit. He has recently been informed that Mr. Pope had given as a reason why he did not think this lamp was made by the Torricellian vacuum, that there would in such case be a deposit of mercury upon the surface of the copper wire which connects the carbon with the platinum wire, and that he discovered no such appearance. He told Mr. Pope he was mistaken, provided that distilled mercury was used in producing the vacuum. The mercury that he used in producing the vacuum in these lamps was carefully distilled, sometimes three or four times, before it was used, and the process was always performed in a dry atmosphere, and other safeguards used, such as heating the mercury slightly. He had also employed, previous to 1872, a mercury pump in which no mercury was present in the glass part of the lamp, but he succeeded better with the Torricellian process than with this early mercury pump As compared with the incandescent lamps of to-day these early lamps gave a fairly good light. He declares he has received no money for his affidavits, and has no interest in this suit, and that he has given his evidence reluctantly, and after considerable urging.

I have given the substance of the leading points of Goebel's affidavits because this case rests largely upon them. With respect to the age and history of lamp No. 4, it may be said that the evidence rests entirely upon his affidavits and that of his son, Henry Goebel, Jr.

The defendants produce some forty affidavits in confirmation of the statement of Goebel respecting his lamp. Of these witnesses, five are his children, one his niece, and the remainder nearly all friends or acquaintances. So far as appears, these people are respectable and truthful. They testify generally to seeing the Goebel electric lamp in his shop and on his wagon containing the telescope, at various times between 1850 and 1882, the time and the circumstances in many instances being given in detail, and some twenty witnesses identify the early fiddle-bow lamps as the same as those which they saw. Several witnesses also observed the lamp connected with the clock. To some, Goebel explained how the lamps were made, and several assisted him in their construction. Some declare the light was good, but do not state the length of time the light would burn. Generally speaking, the testimony is confined to the old fiddle-bow lamp, and relates to a period prior to or about 1860. A number of witnesses testify as to the good character, honesty, and truthfulness of Henry Goebel.

It appears from the affidavit of Mr. Bull, an attorney at law that Henry Goebel, Jr., delivered lamp No. 1 to him at his office in New York, October 18, and lamp No. 2, November 28, 1892, and that when received both the carbons were detached from the leading-in wires, and that he was then informed by Goebel that both the carbons were intact when he put the lamps in his pocket to bring them to his office. Henry Goebel, Jr., states that he delivered lamp No. 3 to Mr. Bull at the same time with No. 2, and that he broke the carbons in lamps 1 and 2 on the way to Mr. Bull's office.

From Mr. Williams' affidavit, it seems that gas was introduced in Monroe Street in or about the year 1854; this, with the testimony of the elder Goebel and other witnesses, fixes the date of the construction of lamps 1, 2 and 3, as early as 1854.

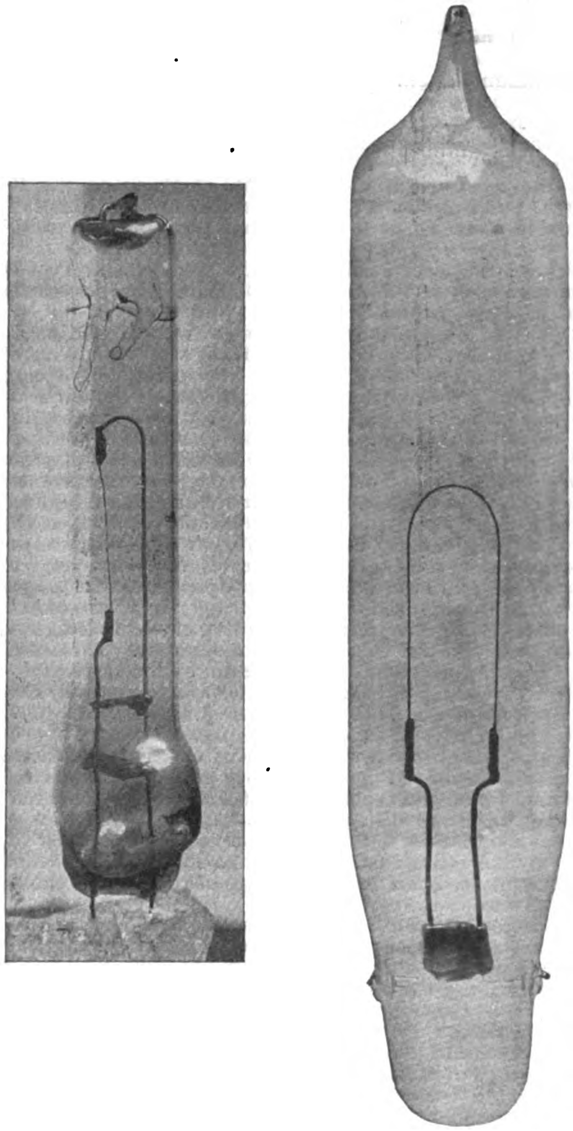
Mr. Curtis, the counsel for the defendants in the New York cases, states that he first heard of Henry Goebel in the early part of 1882, and that in answer to his questions, he said that he had made incandescent lamps like Edison's as early as about 1850. Owing to Goebel's imperfect English he had difficulty in understanding him. He gathered from the conversation that Goebel had not made any use of his lamps except for laboratory experiments, and that his work was not continued for more than a year or two after 1850. He asked him to produce some lamps, and he said he would look them up. His recollection is that he saw Goebel again, but that he had no further information to impart.

In the latter part of 1890, Mr. Bull, who had been counsel for the Consolidated Electric Company, informed him that Goebel's sons corroborated their father's statement and that further additional evidence could be procured, but after consultation with Gen. Duncan they concluded that the evidence was not sufficient to warrant an application to reopen their case to admit it. At the time of the injunction motion in the Sawyer-Man case in November, 1892, he made further inquiry in regard to Goebel, and was informed that some additional evidence had been obtained. Upon consultation with his associates, Mr. Wetmore and Mr. Root, it was concluded that the matter had not been sufficiently developed to present it as a defence in that case. Mr. Curtis goes on to state that, had he known of anything like the character and extent of the Goebel evidence as presented in this case, he should have regarded it of the greatest importance as constituting one of the best defences in their cases.

In further support of the Goebel anticipation, several experts give affidavits to the effect that the Goebel lamp, assuming that it was made prior to 1879, contains the broad invention covered by the second claim of the Edison patent, as it embodies the same combination of a carbon filament with an all-glass exhausted receiver and conductors passing through the glass.

Mr. Pope declares that Goebel lamps 1, 2 and 3 have a carbon filament within the meaning of the second claim of the Edison patent as defined by the Court, a receiver made entirely of glass and exhausted of air, and conductors passing through the glass and all these elements combined for the purpose set forth in the patent; that these structures embodied the conception that carbon would stand high temperature, even when very attenuated, if operated in a high vacuum without the phenomenon of disintegration.

He finds these particular lamps are not now in a condition to be operated, but he is satisfied that when first constructed they were capable of such operation, and had in fact been so operated. He knows of no reason why these lamps should not have been made long prior to 1879, and should not last as long and be as practically useful as many forms of lamp described by Edison in his patent. He finds the leading-in wires in lamps 1 and 2 to be of iron, and in 3 of copper. In No. 3 he finds the leading-in wires are sealed by fusion into the lower end of the glass chamber, the glass being pressed around them when hot. The filament is made of carbonized woody fibre, apparently of bamboo or cane, and has a diameter approximately of eight to ten one-thousands of an inch. The glass chamber is five inches long and seven-eighths of an inch in diameter, but is now cracked near the bottom, and consequently there is no vacuum.



GOEBEL LAMPS, NOS. 1 AND 4.

Mr. Cross confirms these statements, and calls particular attention to the fact that the Goebel carbon is by reason of its small diameter a "filament" as distinguished from a "rod," according to Professor Barker's tables, and in the sense in which that term is used in the Edison patent as judicially construed.

In a second and supplementary affidavit, Mr. Pope says, with respect to the highly-finished Goebel lamp No. 4, which has platinum leading-in wires and hair-pin shaped carbon, that at first he had doubts whether it was constructed as early as Goebel, and his son Henry, said, or prior to 1872. This arose from the circumstance that the joint between the carbon and copper wire appears to have been made in part by electro-plating, and his experience led to the opinion that if the lamp had been first filled with mercury and then exhausted by inverting the tube, in one of the ways Goebel practiced, the mercury would have united with the surface of deposited copper, and some traces of it remained, but as no such traces appeared visible in this lamp, he was led to believe that it must have been exhausted upon a vacuum pump. Upon questioning Goebel however, he found that he had used chemically pure or distilled mercury. Afterwards, Mr. Pope, by experiments, discovered that chemically pure mercury did not adhere to copper, nor leave any discoverable trace. This is the reason why this lamp was not before the Court at the arguments on this motion.

Mr. Pope is unable to get a current through this lamp because the circuit is somewhere broken. He sees no reason why it might not have been made before 1872. He is of opinion that it represents an advance over the prior Goebel lamps in details of construction and general workmanship and that it is entirely capable, with the break repaired, of practical use as an incandescent lamp. He thinks it would burn without doubt three or four hundred hours, and that it clearly embodies the invention of the second claim of the Edison patent, as construed by the Court. He is also of opinion that iron leading-in wires are practicable in the construction of an incandescent lamp, and the next best thing to platinum. Mr. Cross, in a supplemental affidavit, confirms these statements. Mr. Cary, the electrician of the defendant company, states in an affidavit, that from experiments he has recently tried incandescent lamps capable of practical use can be made with iron leading-in wires.

There was filed at the same time with the foregoing supplemental affidavits, other affidavits of persons who knew Goebel and saw his lamps. The light from the Goebel lamp seems to grow brighter and more steady as the affidavits multiply. For example, Mr. Voss, in his second affidavit, says: "Some of the larger lamps were attached in the store like gas fixtures. . . . I have seen the store lighted with these electric lamps alone when the gas was turned off, and the light in the store was a nice brilliant light of, I should say, from eight to ten candle power to the lamp." Again, Mr. Hall states that the store was entirely lighted up by these lamps, which were brighter than gas jets; in fact, too bright, and that the light was very steady. Mrs. Stark says the lamps were brighter than an oil lamp or gas flame, and would burn an hour, George Pasbach, who married Goebel's niece, declares he could see to read by their light, and do fine work. Edward F. Mulligan says the lamps in the Monroe Street store gave a nice bright light, whiter and much better than gas, and that you could easily read or do work by it.

To meet this alleged Goebel anticipation, the plaintiff introduces the prior adjudications upon the Edison patent, the affidavits of Edison and Barker relating to the history of the invention and the prior state of the art, and the affidavit of Upton shows that the defendant company was incorporated in 1890, and is now an active competitor in manufacturing and selling incandescent lamps. The plaintiff also produces the affidavit of Professor Elihu Thomson to the effect that the Goebel lamps, like Exhibits 1, 2 and 3, could not have been useful for ordinary lighting purposes, and were never a practically operative light. One reason for this is, because the leading-in wires are of iron or copper, under which conditions a vacuum cannot be maintained, since the rate of expansion of iron and copper is very different from glass, the result being that the lamp begins to lose its vacuum as soon as it is heated and cooled. Another reason is that the leading-in wires are poorly and crudely sealed in, the glass work being thoroughly bad, and the lamps cracked and blackened on the ends by improper flame. While these lamps, in spite of leakage, might have been used for a short time, they could not have had a sufficient brilliancy for ordinary lighting purposes, nor possessed any commercial value. The vacuum not being maintained the heat would be carried away from the incandescent body by currents of gas, and this waste of energy robs the burner of its light-giving power. This statement, by Prof. Thomson, is agreed to and confirmed by the affidavits of John W. Howell and John E. Randall.

Prof. Thomson further says, that he remembers Henry Goebel as far back as 1881 or 1882, and that he visited his shop at that time, and that an endeavor was made to impress him with the value of the Goebel anticipation.

The plaintiff also, by permission of Court, filed affidavits after the arguments on the motion. These are important, not only as contradicting statements found in the affidavits of defendants but for other reasons.

A number of these witnesses, who were neighbors or acquaintances of Goebel, or had other means of knowledge, deny that he exhibited any electric lights in connection with his telescope or in his shop, about 1860 or the years following.

There are the affidavits of John W. Howell and Frank Holzer, electricians, who corroborate the statement of Prof. Thomson that the Goebel lamps, 1, 2 and 3, were never practically operative by reason of a defective vacuum, and never possessed any commercial value.

Several witnesses state that Goebel spoke English well, and it is also proved that articles relating to the subject of incandescent lamps and Edison's inventions were printed during 1880, in the *Staats-Zeitung*, a German daily newspaper, published in New York.

But the more important evidence has reference to those persons who saw or dealt with Goebel, and who investigated his claim to have anticipated Edison in the art of incandescent lighting.

William C. Dreyer states that he undertook to form a company to purchase from Henry Goebel his inventions and patents, and that in 1882 he did procure from him an option for three months of all his inventions relating to electric lighting upon payment to him of $500, and an extension of the option for another three months, for which an additional $425 was paid. Goebel was also to have a large compensation from the company if formed. At that time, he said he had patented or applied for patents on a mercury pump, and a spiral holder for the carbon in an incandescent lamp. He said he had made small incandescent lamps called the fiddle-bow. It was considered of great importance to have one of these lamps, and he made every effort to find one, but never succeeded. The conversations with Goebel were carried on in German. The production of an old lamp was vital in this matter. During this time, negotiations with the Edison Company were attempted through S. B. Eaton. The whole subject was gone over with E. N. Dickerson, the patent lawyer, who said that even if Goebel did what he claims, it was nothing but an abandoned experiment. The negotiations with the Edison Company were in consequence dropped.

Albert Hetschel, a manufacturer of thermometers and scientific apparatus, states that in 1881 he was in the employ of the American Electric Light Company, and was directed to work with and help Henry Goebel, and was at his shop for several months. Hetschel describes how Goebel in a crude way made three or four little incandescent lamps with the use of a poor vacuum pump; that he was unable to make a successful lamp, and he is certain that if he had possessed at that time any incandescent lamps he would have shown them.

Otto A. Moses, a mining engineer, then in the service of the Edison Company, visited Goebel in 1884. Goebel made some carbons for him. During this time, being much interested in the subject, he inquired of Goebel what he had done in the field of incandescent lamps. He examined all the lamps Goebel had and asked him to produce some of his old ones. Goebel requested permission to visit his laboratory and did so, and afterwards solicited employment for himself and his son. Under these circumstances, he says it is improbable that Goebel at that time had any old meat-saw or hair-pin lamps in his possession.

Ludwig K. Bohm, an electrical expert, who was associated with Edison in 1879, and afterwards in 1881 electrician of the American Electric Light Company, had several conversations with Goebel at the office of the company. At that time Edison's invention had been published in the English and German papers in New York. He conversed with Goebel in German on the subject of incandescent lighting, and he is certain that he would have mentioned his historical lamps if he had made them.

He then proceeds to discuss the lamps described in Goebel's affidavit, and declares that a vacuum sufficiently high to enable a filamentary carbon to last could not be made by filling the tube with mercury, and then inverting it, because there is always air in the mercury, and that air also clings to the glass walls. In making standard barometers by the Torricellian vacuum it was found necessary to boil them out for hours in specially constructed apparatus. Further, owing to the specific gravity of mercury the filamentary carbon would be broken during the operation of filling and inverting the chamber. The lamps are likewise imperfect from the use of iron or copper leading-in wires, and no one of them shows any evidence that it ever contained a good vacuum.

William McMahon in 1880 was interested in starting a company to compete with the Edison lamp, and he and his associates, George Crosby and Edwin Fox, organized the American Electric Light Company in 1881. Crosby took him and his brother to Goebel's shop to talk over electrical matters. Goebel showed him an arc lamp, but said he had never made any incandescent lamps. He remembers also seeing some carbons and a vacuum pump which appeared like a swinging pump. Goebel's son was soon after employed by the American Company. There was intense excitement at this time over the Edison incandescent lamp. Everybody recognized that Edison had made the invention. There was every reason at the time why Goebel and his son should have disclosed fully what they had done in this direction. If any one had preceded Edison in his invention, unlimited capital could have been secured for an opposition company. The American Company wanted to make the Edison lamp but did not dare to. For these reasons he is satisfied that Goebel never made an incandescent lamp prior to March, 1881. Thomas G. McMahon, his brother, confirms this story in his affidavit.

Sherburne B. Eaton, the legal adviser of the Edison Company, states that in May, 1882, the law firm of Dickerson & Dickerson called his attention to the alleged inventions of Henry Goebel. They said that he claimed to have invented an incandescent lamp resembling the Edison. Goebel's representative in this matter was William C. Dreyer. No price was made, but they were asked to look into the matter. The subject was laid before the Executive Committee of the Edison Company, and it was decided that Goebel had nothing worth buying. Mr. Dickerson's opinion was that if Goebel had made the inventions he claimed, they amounted to nothing more than an abandoned experiment. On November 28, 1882, Henry Goebel, Jr., called upon him, as representing the Edison Company, and made another offer to sell the inventions and good will of his father, naming the price of $20,000, and the matter was again submitted to the company. On December 12, 1882, he called again and was informed that the company did not wish to buy.

A patent was issued to Henry Goebel for an improvement in electric incandescent lamp, October 24, 1882. This invention has reference to securing and cementing the carbon burner into flattened and spirally coiled ends of the conducting wires. The second claim, as drawn in the original application, was rejected by reference to the Edison patent, now in suit.

Upon consideration of the whole of the evidence on this motion I have reached the following conclusion:

It is extremely improbable that Henry Goebel constructed a practical incandescent lamp in 1854. This is manifest from the history of the art for the past fifty years, the electrical laws which since that time have been discovered as applicable to the incandescent lamp, the imperfect means which then existed for obtaining a vacuum, the high degree of skill necessary in the construction of all its parts, and the crude instruments with which Goebel worked.

Whether Goebel made the fiddle-bow lamps 1, 2 and 3 it is not necessary to determine. The weight of evidence on this motion is in the direction that he made these lamps or lamps similar in general appearance, though it is manifest that few, if any, of the many witnesses who saw the Goebel lamp could form an accurate judgment of the size of the filament or burner. But assuming they were made, they do not anticipate the invention of Edison. At most they were experimental toys used to advertise his telescope, or to flash a light upon his clock, or to attract customers to his shop. They were crudely constructed, and their life was brief. They could not be used for domestic purposes. They were in no proper sense the practical commercial lamp of Edison. The literature of the art is full of better lamps, all of which were held not to anticipate the Edison patent. The prior art demonstrates that to protect a carbon filament ten one-thousandths of an inch in diameter from speedy disintegration, the lamp chamber must maintain a nearly perfect and stable vacuum, and every part of the structure must be composed of such materials and so put together as not to imperil this vital condition. Leaving out other defects, it is abundantly shown that the Goebel lamp did not possess this requirement, and could not by reason of the elements which entered into its composition and the mode in which it was constructed. Goebel says he made more than a hundred lamps, and that a continual improvement took place in their construction, and yet the only three lamps produced at the hearing by his own confession were made as early as 1854, or before gas was introduced into his house. Where are the other lamps, which show these improvements except Exhibit 4, which I will deal with presently? The evidence of Goebel and his witnesses point to the conclusion that work ceased on these lamps in the "fifties," and was not revived until Edison twenty years later startled the electric world with his invention. Goebel brought from Germany the ideas contained in the old lamp of Starr, with its carbon pencil enclosed in a Torricellian vacuum, and he probably constructed some lamps after that pattern. In doing this he was up to and in line with the art as it existed at that early day, but to say that with a sudden bound he jumped from Starr to Edison passes the limits of credulity. The history of great inventions shows a gradual and labored progress. Each new investigator records some advance until it may be the desired discovery is almost within his grasp, but it is only after many attempts and many failures that some one appears who accomplishes the long sought for result. The discovery of the domestic incandescent lamp is no exception to this rule, as the record in the New York case bears witness. Speaking from the standpoint of the art of incandescent lighting in 1854, and in 1892, are two different things, and it is, therefore, quite easy for witnesses to think that Goebel did much more than there is any legitimate reason to suppose.

As for lamp No. 4, I cannot but view it with suspicion. It presents a new appearance. The reason given for not introducing it before the hearing is unsatisfactory. This lamp, to my mind, envelopes with a cloud of distrust the whole Goebel story. It is simply impossible under the circumstances to believe that a lamp so constructed could have been made by Goebel before 1872. Nothing in the evidence warrants such a supposition, and other things show it to be untrue. This lamp has a carbon filament, platinum leading-in wires, a good vacuum, and is well sealed and highly finished. It is said that this lamp shows no traces of mercury in the bulb because the mercury was distilled, but Goebel says nothing about distilled mercury in his first affidavit, and twice he speaks of the particles of mercury clinging to the inside of the chamber, and that for this reason he constructed a Geissler pump after he moved to 468 Grand street, which was in 1877. Again, if this lamp has been in his possession since before 1872, as he and his son swear, why was it not shown to Mr. Crosby, of the American Company, when he visited his shop in 1881, and was much interested in his lamps? Why was it not shown to Mr. Curtis the leading counsel for defendants in the New York cases, when he was asked to produce a lamp and promised to do so? Why did not his son take this lamp to Mr. Bull's office in 1892, when he took the old fiddle-bow lamps 1, 2 and 3? Why did not his son take this lamp to Mr. Eaton's office in 1882, when he tried to negotiate the sale of his father's inventions to the Edison Company? A lamp so constructed and made before 1872 was worth a large sum of money to those interested in defeating the Edison patent like the American Company, and Goebel was not a rich man. Both he and one of his sons were employed in 1881 by the American Company. Why did he not show this lamp to McMahon when he called in the interests of the American Company and talked over electrical matters? When Mr. Dreyer tried to organize a company in 1882, and procured an option from him of all his inventions relating to electric lighting, for which $925 was paid and when an old lamp of this kind was of vital consequence and would have insured a fortune, why was it not forthcoming? Mr. Dreyer asked Goebel to produce an old lamp and was especially anxious to find one pending his negotiations with the Edison Company for the sale of Goebel's inventions. Why did he not produce this lamp in his interviews with Bohm of the American Company, or Moses of the Edison Company, when it was for his interest so to do? The value of such an anticipation of the Edison lamp was made known to him. He was desirous of realizing upon his inventions. He was proud of his incandescent lamps, and was pleased to talk about them with anybody who would listen. Is it conceivable, under all these circumstances, that he should have had this all-important lamp in his possession from 1872 to 1893, and yet no one have heard of it or seen it except his son? It cannot be said that ignorance of the English language offers an excuse. He knew English very well, although Bohm conversed with him in German. His children spoke English. Neither his ignorance nor his simplicity prevented him from taking out three patents, the first in 1865 for a hemmer, and the last in 1882 for an improvement in incandescent lamps. If he made lamp No. 4 previous to 1872, why was it not also patented?

There are other circumstances which throw doubt on this alleged Goebel anticipation. The suit against the United States Electric Lighting Company was brought in the Southern District of New York, in 1885. Large interests were at stake, and the main defence to the Edison patent was based upon prior inventions. This Goebel claim was then investigated by the leading counsel for the defence, Mr. Curtis. It was further inquired into in 1892, in the case against the Sawyer Man Company. It was brought to the attention and considered by the Edison Company in 1882. It was at that time known to the American Company who hoped by this means to defeat the monopoly under the Edison patent. Dreyer tried to organize a company for its purchase. Young Goebel tried to sell it. It must have been known to hundreds of people. And now when the Edison Company after years of litigation, leaving but a short time for the patent to run, have obtained a final adjudication establishing its validity, this claim is again resurrected to defeat the operation of the judgment so obtained. A Court of Equity should not look with favor on such a defence. Upon the evidence here presented, I agree with the first impressions of Mr. Curtis, and with the opinion of Mr. Dickerson that whatever Goebel did must be considered as an abandoned experiment.

It has often been laid down that a meritorious invention is not to be defeated by something which rests in speculation or experiment, or which is rudimentary or incomplete. The law requires not conjecture, but certainty. It is easy after an important invention has gone into public use for persons to come forward with claims that they invented the same thing years before, and to endeavor to establish this by the recollection of witnesses as to events long past. Such evidence is to be received with great caution, and the presumption of novelty arising from the grant of the patent is not to be overcome except upon the most clear and convincing proof. *Coffin* v. *Ogden*, 18 Wall, 120; *Brush* v. *Condit*, 132 U. S. 89; *The Telephone Cases*, 126 U. S.; *American Bell Telephone Company* v. *People's Telephone Company*, 22 Fed. Rep. 809; *Motte* v. *Bennett*, 2 Fisher, 642; *Parham* v. *American Buttonhole Company*, 4 Fisher, 468; *La Baw* v. *Hawkins*, 1 Ban. & Ard. 428; *Gottfried* v. *Philip Best Brewing Company*, 5 Ban. & Ard. 4; *Worswick Manufacturing Company* v. *City of Buffalo*, 26 Fed. Rep. 128.

When the defendant company entered upon the manufacture of incandescent lamps in May, 1891, it well knew the consequences which must follow a favorable decision for the Edison Company in the New York case.

Owing to the large interests involved, I have carefully considered this motion, and I am satisfied upon the evidence, and the law applicable thereto, that it should be granted.

Injunction granted.

GOVERNMENT SUIT TO ANNUL THE BERLINER TELEPHONE PATENT.—I.

In The Electrical Engineer of February 15 brief mention was made of the suit brought by Attorney-General Miller against the American Bell Telephone Company and Emile Berliner, in the Circuit Court of the United States, District of Massachusetts, for the annulment of the Berliner patent of November 17, 1891, No. 463,569. This patent covers broadly the "Contact" or microphone form of speaking telephone transmitter; the only variety of transmitter hitherto successfully employed commercially. It has undoubtedly been the expectation or hope of the American Bell Telephone Company that through its possession of this patent it would be able to extend its patent monopoly of practical telephony for many years after the expiration of the fundamental Bell patent in March next. The Blake transmitter patents have expired because of the termination of prior foreign patents, as is generally known; and, according to Circuit Court decisions in similar cases, the Edison telephone patents issued last year are now void for the same reason. Thus the Berliner patent, far more sweeping and comprehensive in scope than any other transmitter patent, would seem to be the main reliance of the Bell company for the maintenance of its control of practicable forms of telephones when Bell's patents shall have expired.

The validity of the Berliner patent has been questioned by many persons familiar with patent law, on various grounds; and, in view of the public interest involved it is obviously a general advantage that the Department of Justice has brought suit to determine its status, and it will be a further benefit if the case can be pressed to a speedy issue.

The allegations of the Government bill are many and various. One of the most significant is, that, in Berliner's application, filed June 4, 1877, he described a telephone transmitter which depended upon the *make-and-break* of contact between the electrodes, and that *no other kind* of transmitter was described in the application; while in the patent as issued, the *make-and-break* transmitter had been eliminated and another substituted which depended for its operation upon *constant contact* between the electrodes; and that the amendments and substitutions were made after Berliner had assigned his invention to the Bell company. The bill further shows that after Berliner's assignment he filed applications and received six patents during the years 1879–1881 for telephones operating upon the constant contact principle, in every one of which there is present the same broad feature that is an element in the broad claims of the patent of 1891 issued upon his application of June, 1877; and the bill avers that it is against justice and equity and contrary to the plain spirit and intent of the patent laws that the monopoly of one and the same invention shall be prolonged in one and the same person by the grant, first, of a patent or patents for the invention in practical or applied form, and afterward of a patent covering nakedly and broadly the fundamental principle of the same invention. It is then pointed out that from the time of acquiring ownership of Berliner's invention the Bell company, up to the issue of the patent in question (November, 1891), not only had control of Berliner's application of June, 1877, but owned the inventions and patents of Blake, Berliner, and others, under which it was enjoying a monopoly of the use of the broad invention of the constant contact telephone transmitter, and that therefore the Bell company was in duty bound to speed the progress of Berliner's application by every legal means; and that if by any act, or failure to act, on its part, the issue of the patent was unduly delayed, such delay ought to and does invalidate it. The complaint alleges that the Bell company, so far from performing its duty in this regard, did intentionally prolong and delay the pendency of the application of Berliner more than thirteen years, for the purpose of prolonging its monopoly.

Much stress is laid upon the amendments of Berliner's application and the substitutions of new drawings by the attorneys of the Bell company. "This amended specification," the complaint says, "was drawn with consummate art and with intent, as your orator believes and charges, to mislead and deceive the Examiner of the Patent Office by concealing from him that the amendment introduced into the application a new and substantial invention not found in the original application." At length Berliner filed an affidavit in which he said that the matter described in the substitute was invented by him prior to filing the original, and formed part of his original invention."

ELECTRIC RAILWAY DEPARTMENT.

LONG ELECTRIC RAILROADS IN OHIO.[1]

Unless present projects greatly miscarry, the building of electric railways through the country districts and between small cities in northern Ohio will be carried on a much more extensive scale the coming summer than ever before. It is being more generally recognized on all sides that electricity is the best motive power for local travel where the patronage is limited, and plans for the development of traffic between small centres of population and in suburban districts by means of it are proposed on every hand. The construction of electric lines between small cities has already been rather notable in extent in the northern districts of Ohio, and the investments have proven so satisfactory that it is comparatively easy to secure capital for new lines. This city is noteworthy for its electric street railways, and the prosperity of these enterprises has been influential also in stimulating the building of country electric roads.

The most conspicuous projects fully decided upon is the line from East Cleveland to Willoughby, the pretty little lake-shore village 18 miles east of this city. The Lake Shore and Michigan Southern and the Nickel-Plate Roads both touch Willoughby, so that its communication with this city is already good; but the East Cleveland Electric Railroad Company, which has covered the choicest residence districts of this city with its lines, and for several years has operated a suburban line out Euclid road three miles to Collamer, will build through to Willoughby in the spring. It extended its road four miles beyond Collamer last summer and will construct the remainder as soon as possible. The line when complete will lie through many of the finest vineyards in Ohio and open up a very desirable suburban residence district. It has already done much to enhance real-estate values, though its projectors had no such end particularly in view, and fairly conservative gentlemen near Willoughby confidently expect property along the new line there to double in value within a year after it is in operation. It is likely the line will be used to market grapes and produce from truck farms to some extent, but it would undoubtedly prove a good investment if it had nothing but strictly passenger traffic to depend upon.

The most extensive system yet proposed has not taken positive form, but the nucleus for it exists, as in the case named above, and there is good reason to expect that considerable extension will occur this summer, even if all that is now proposed fails of accomplishment. A year ago a road was built between the thriving manufacturing cities of Canton and Massillon, nine miles in length, and is operated very successfully, cars running every hour or oftener during the day. Between Warren and Niles also, and in Youngstown and Alliance, electric roads have been in operation for months. Now it is proposed to connect Akron with Canton, 23 miles away, Canton with Alliance, 18 miles distant, and Alliance with Niles by a road less than 25 miles long. If this is carried out, all the thriving industrial centres in northern Ohio outside this city will be connected by electric lines.

From Akron a line will be constructed in early summer to Cuyahoga Falls and Silver Lake, four miles away, and will unquestionably prove profitable, though two railroads now connect the falls with Akron, and the pretty picnic resort at Silver Lake is not far away. The right of way is now being secured from the falls also to Ravenna, fifteen miles distant, taking in the thriving little city of Kent by the way, and two syndicates are competing to secure the franchise from the Portage County Commissioners. If a map is consulted, it will be seen that these projects, in every case, will connect towns between which direct railway communication now exists, and electricity will thus compete with steam in a sense. It is already doing this successfully in a number of cases; the Canton and Massillon and the line between New Brighton, Pa., and Beaver Falls, which was built by Mr. W. W. Hazard of this city, are notable recent instances The first electric road connecting two towns in Ohio, that between Canal Dover and New Philadelphia, in Tuscarawas County, which has now been in operation two years and a half, had to compete directly with a steam railway and has been profitable from the beginning. The greater frequency of the cars and lower fare are the principal reasons for success. Neighborhood communication increases greatly with facilities, and a train every hour, with fare about one-half that on steam roads, more than doubles the travel between country towns. Where there are no heavy grades necessitating cuts, an electric road can be built and equipped with power for $5,000 to $8,000 per mile, and in few cases does the cost exceed $10,000. For a line three miles long four employees are sufficient to man the power-house and run a car every hour, and the expense for repair of roadbed, wires, etc., is very small. A comparatively small revenue, therefore, pays a fair return on the investment.

The most expensive electric road yet built in Ohio, and perhaps in the country, is that between Wellsville and East Liverpool. It is five miles long and connects two thriving manufacturing towns which hitherto have never had direct rail communication, because of the very broken, hilly character of the country between them. Cuts thirty feet deep had to be made in its construction, and in some places a twenty-foot roadway was cut through fifteen and twenty feet of solid rock. The entire cost, including rolling stock, has been placed at $300,000, but that is doubtless a high figure. It was built by Cleveland capital and has been profitably operated for over a year, to the great advantage of both towns. Farther south at Wheeling, W. Va., another Cleveland syndicate controls lines connecting Wheeling with Bellaire, Martin's Ferry, and Benwood, having about eight miles of track outside the municipal limits.

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[1] *Special Correspondence from Cleveland* in the *Evening Post*, New York, Feb. 15, 1893.

In northwestern Ohio another large project is being agitated. The Tiffin and Fostoria Electric Railway Company has already been incorporated, with $175,000 capital stock, to build a road 18 miles long between the two thriving towns in question. Hon. Charles Foster, ex-Congressman George E. Seney, and other less prominent capitalists are back of it. The country through which the line is to be built is comparatively level, and it is proposed at several of the more picturesque spots to secure and improve land for parks and picnic grounds. The investment of the company will depend, of course, very much upon the amount of land purchased for such purposes, but it cannot be questioned that the capitalization is greatly in excess of the actual cost of constructing the road itself. This road will be one link in a system for which subscriptions and right of way are now being secured, which, as projected, will be nearly 100 miles in length. It begins at Ottawa city on the northernmost point of Catawba Island, which is in reality a peninsula and part of one of the greatest fruit-growing districts in the Central West, and runs thence to Port Clinton, whence it is to be extended to Fremont, Fostoria, and Findlay, and touch many villages en route. As there are few hills to be encountered, the cost of construction would be small and the road would be very convenient in marketing the grapes and peaches in their season. The Port Clinton and Ottawa City Line is expected to be in operation by the 1st of August. In the same section of the state another line will be constructed the coming summer, connecting Sandusky with Milan, Huron, and Norwalk. Besides these the building of a considerable number of suburban lines, extensions, and small city roads is under discussion.

This great development of electric roads has led to some legislation already and promises to be followed by more. Last winter Martin Dodge of this county, who is a great enthusiast on the subject, introduced and secured the passage of a measure that enables electric railroad companies to bring condemnation proceedings against any turnpike or plank-road company to obtain the right to occupy part of the roadway when the two companies cannot agree to terms and conditions without appealing to the courts. It is local in scope, applying only to this county; and was the first legislation of its kind in the country. It is part of a plan to build a system of electric roads from Corlett Station to Chagrin Falls, and from Chardon, Geauga County to the Falls, which will probably take tangible form this summer, a suburban road being extended three miles beyond the southeastern limits of the city to connect with the projected system at Corlett Station. A number of prominent local real estate men are interested in the scheme, which contemplates carrying freight as well as passengers. 23 miles of road would be included in the system, and notwithstanding the hills encountered toward the eastern end of the line, its estimated cost is but $100,000. This, however, does not include power station and rolling stock.

The electric roads thus far have a peculiar status in Ohio. The Railroad Commissioner has recently called attention to the fact and urged action. The Canton and Massillon, and Granville and Newark roads, for example, carry both freight and passengers, have contracts for carrying the United States mails, and are common carriers for an express company. In a word, they differ from other railways only in motive power used. Yet they cannot be considered amenable to the railway laws of the commonwealth. For this reason, no official statistics are obtainable of their earnings, capital, etc. No data are being collected for a future use, although all such roads, being built along public highways, sometimes occupying part of the roadway, enjoy exceptional privileges and will in time call for special regulation. It is probable that a bill will be passed making the other railway laws of the state applicable both to country electric lines and street railways. This would bring them under the supervision of the State Railroad Commissioner and insure the collection of full and reliable statistics. The rapid development of the roads makes this very necessary for the future protection of the public.

A VERY LONG TROLLEY ROAD FOR PENNSYLVANIA.

THE charter granted to a trolley road, eighty miles in length, by the State Department at Harrisburg last week, has caused a feeling of alarm among steam railroad officials. The road is called the Northumberland, Bloomsburg and Scranton Street Railway Company, and connects thirty-nine towns in that region. Among them are Lackawanna, Pittston, Catawissa, Mechanicsville, and Nanticoke. It is a very busy centre, and the establishment of a trolley line will materially interfere with the local traffic of the steam roads. At the office of the Reading Railroad Company it was stated that these roads were generally given the privilege to run over the turnpikes and township roads, thus saving the expense of grading, the largest item of the steam roads' expense in a mountainous country. It was acknowledged that it would make a difference in the revenues of the companies with which such road came in competition. The capital of the new road is $500,000, and it is said that a syndicate in Philadelphia is furnishing the money.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

WE give below the Fifteenth Convention programme of the National Electric Light Association, St. Louis:—

Tuesday, February 28, 1893, Meeting of the Executive Committee at 9 a. m., parlor, Southern Hotel. Morning Session, 10.30 o'clock, Bell Telephone Building. Address of welcome, Hon. E. A. Noonan, mayor of St. Louis; address, president Jas I. Ayer; report of Committee on Data. Afternoon Session, 2 o'clock. Report of Committee on Safe Wiring; report of Committee on World's Columbian Fair; paper by A. D. Adams, "Wrought *vs.* Cast Iron for Field Magnet Frames."

Wednesday, March 1, Morning Session, 10 a. m. Paper by H. C. Myers, "Preservation of Poles and Cross Arms"; paper by Chas. S. Bradley, "Long Distance Transmission of Power"; paper by L. B. Stillwell, "Under What Conditions is the Use of Water Power Economical." Wednesday Afternoon Session, 2.30 o'clock. Paper by E. A. Armstrong, "Morals of Corporations"; paper by R. H. Sterling, "Some Experiences With the Alternating System"; paper by William Brophy, "Relation of Insurance to Electric Lighting and Power." Wednesday Evening Session, 8 o'clock. Lecture by Nikola Tesla.

Thursday, March 2, Morning Session, 10 o'clock. Paper by W. H. Browne, "Underground Conduits and Conductors"; paper by Calvert Townley, "Incandescent Lamps From a Commercial Standpoint"; paper by Dr. Louis Bell, subject to be announced. Thursday Afternoon Session, 2.30 o'clock. Paper by Prof. Geo. Forbes, of London,. Executive Session. Report of secretary and treasurer; election of officers.

THE POWER PLANT AT THE WORLD'S FAIR.[1]

THE power plant at the Columbian Exposition occupies nearly seven acres, or about one-fourth of the entire floor space of the "Palace of Mechanic Arts," popularly known as Machinery Hall. The plan is given in the supplement to this issue. The boiler-house, immediately adjoining, is 627 feet long and 86 feet wide, with an addition of the same width and 200 feet in length. About 25,000 h. p. will be generated here in water tube boilers of various makes.

The space allotted to the power plant, 100 feet wide by 1,000 long, is divided into 14 sections, separated by aisles, and the machinery is arranged within these sections in classified groups.

These 15 blocks comprise what is known as the power plant proper, including the arc lighting section, the incandescent section and the power section, and the total indicated horse power of the 40 engines employed is about 18,000 at maximum economical load.

Oil will be used for fuel. The storage reservoir is 3,200 feet from the power plant, on the shore of the lake, and consists of eight tanks having an aggregate capacity of 112,144 gallons, sufficient to develop 393,400 h. p. hours. The oil is pumped into a stand-pipe, whence it flows to the boilers. All important valves in this installation are electrically operated, and the burners under the boilers are electrically connected with the pressure gauges and are automatically regulated.

The work of planning and installing the power plant was carried out by Mr. Frederick Sargent, the chief mechanical and electrical engineer of the Exposition, ably assisted by a judiciously selected and efficient staff of associates.

ELECTRICITY AT THE WORLD'S FAIR.

THE balance sheet of the World's Fair, to date, shows the following disbursements:—Electricity building, $416,428; electric plant, $284,300; electrical engineering, $48,699; office building for mechanical and electrical departments, $8,250; police signal boxes, $8,881; machinery building, $978,496; mechanical engineering, $32,000; boiler plant, $38,494. On the receipts side is an item of $5,813, for electric power furnished.

PROF. GEORGE FORBES, F. R. S., has just arrived from England, to attend to his consultation work on the Niagara power transmission project. He has been invited to participate in the St. Louis convention, and will probably do so.

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[1] Abstract, with Supplement Illustration, from *World's Fair Electrical Engineering.*

MISCELLANEOUS.

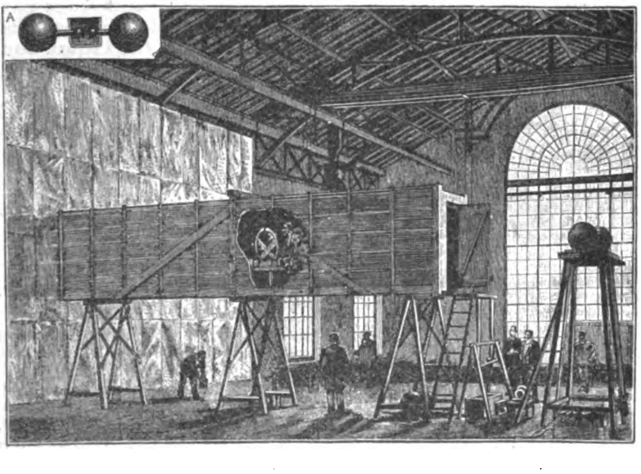
EXPERIMENTS OF MM. SARASIN AND DE LA RIVE ON ELECTRICAL OSCILLATIONS.

THE experiments first undertaken by Hertz to demonstrate the existence of electric oscillations and waves similar in character to those involved in the propagation of light, have been taken up by a number of investigators who have carried them out to a degree of accuracy which leaves little doubt of their actual existence.

At the beginning of his researches Hertz believed that he had found that the waves traveling within the wire had a speed equal to only .6 of that of light, although he gave this result as a mere provisory observation. This conclusion was not fully substantiated by the first experiment of MM. Sarasin and De La Rive, but these conscientious and dexterous experimenters were not satisfied with that. Judging that the dimensions of their laboratory at Geneva were too small to put the matter to a test, they tore down the partitions, but without modifying the result. Finally at the request of Prof. Hertz himself they decided to operate on a larger scale and removed their apparatus to the turbine room in the motive power station of the Rhone.

The accompanying engraving taken from *La Nature* shows the enormous scale of these experiments. At the right is shown the exciting apparatus which produces the oscillatory spark. The electro-dynamic action is propagated in all directions and strikes the reflector of zinc at a distance of 50 feet. This zinc reflector is 25 feet high and 50 feet long. The electrodynamic wave is thrown back on itself from the reflector, and in this way the ventral and nodal points of oscillation can be observed. For this purpose it is only necessary to shift backward and forward a small metallic loop, the ends of which almost close upon each other and leave only a small distance between the ends of the wire. At the nodal points nothing in particular is perceived; at the ventral points, however, the induced spark constantly plays between the small balls at the ends of the loop.

In order to observe in the dark and to operate more commodiously, the experimenters have constructed a tunnel of wood in the axis of which the phenomena can be observed, as shown in the illustration. The oscillator is shown in enlarged view at A, in the upper left hand corner of the engraving, and consists of two large spheres from which project two smaller ones which are immersed in oil. Knowing the distance from node to node, the length of the wave is deduced, being double that distance. Besides this, it is known how to calculate the number of oscillations per second to produce an action in the receiving loop, analogous to the acoustic resonator of Helmholtz, this loop, in fact, being called a resonator. This number multiplied by the length of the wave, as measured, gives the speed of propagation of the electrodynamic action, provided there is, of course, no error in the reasoning, but this is just the point upon which physicists are not yet entirely in accord.

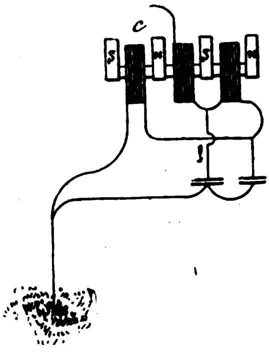


APPARATUS FOR STUDYING ELECTRICAL OSCILLATIONS.

Supposing it to be correct, however, MM. Sarasin and De La Rive have re established by their large installation the identical results which they had observed in their smaller ones, namely, that the speed of propagation of electrodynamic action in free air is the same as that along the length of the wires, that is to say, at their surface, while on the interior of the wire these waves are not propagated at all. By the processes sketched briefly above M. Blondlot has demonstrated in a direct way that this speed is equal to that of light.

The measurement of the speed of propagation of the electric waves in various media has also been made the object of very interesting researches. M. Cohn has found, for example, that the speed in water is 8.5 times smaller than that in air, and this is exactly the value of the index of refraction of water to electric waves found by M. Ellinger. The square of this number 72 is very nearly the value of the dielectric constant of water. The index of refraction of alcohol, equal to 4.8, leads to the same verification, and hence agrees with the theory of Maxwell.

THE FIELD VIBRATORY TELEGRAPH.



Field Non-Inductive Relay.

WHEN electric vibrations or undulations of a very rapid character are transmitted over a circuit it is found in practice that a distance limit over which reliable communication is possible is soon reached. This is especially the case in transmission of speech and in such systems of multiplex telegraphy as utilize a great number of vibrations or undulations on the line at the same time. In order to increase indefinitely the distance limit of such communication, Mr. Stephen D. Field provides transmitting apparatus which will produce greater fluctuations of the transmitting current, using relays to throw upon the distant section of the line vibrations or undulations of greater E. M. F. but of the same character as those received by the relays.

Mr. Field's invention comprises a receiver of great sensitiveness to electrical vibrations, capable of use as a receiver in a simple circuit or as a relay for repeating vibrations into other circuits.

For the purpose of raising the tension of the current so as to give the same a high E. M. F. and render it capable of overcoming a great line resistance, Mr. Field uses a dynamo with carbon brushes on its commutator and provided with two circuits, one of which is operated by the undulations the tension of which is to be raised, and the other connected to line circuit.

The damping effect produced upon vibrations of minute periodicity where a wire is coiled parallel to itself may be largely overcome by arranging a battery of small magnets in series, each of a size to accommodate the most minute impulses employed. The line currents after passing the first magnet find a return through a condenser provided between the coil or magnet and the one next in series, a more prolonged impulse serving to fill this condenser and energize the next magnet of the series, and so on through the set. To adapt this arrangement to the Field receiver the apparatus shown in the accompanying illustration is used. The current first passes through the centre coil, thence through the one to the right and finally that to the left, finding partial circuit in transit *via* the condenser.

ELECTRIC POWER IN DRIFT MINING.

THE electric power and lighting-plant installed by the Electrical Engineering Cpmpany, of San Francisco, for the Dardanelles mine, Placer county, Cal., says the San Francisco *Mining and Scientific Press*, consists of a 25-horse power Keith electric generator, a 6-h. p. electric pump, a 6-h. p. electric hoist and 50 incandescent lamps. The pump and hoist are operated by Keith motors. The electric plant was substituted for the cable transmission previously used.

By the substitution of power transmission by electricity, the expense has been reduced to the minimum, so that the initial expenditure for power has been decreased fully three-quarters.

During four months of each year steam power must be used, because the water power belonging to the mine is not then available. Three cords of wood were used each day to run the cable, but less than one cord is necessary by the electric system, even when the 25 electric lights in the tunnel and incline are continually lighted. The further saving of wear and tear is of much importance. No additional men to those otherwise employed in the mill and mine are engaged in operating the electric plant.

COLLEGE NOTES.

THE UNIVERSITY OF WISCONSIN is doing a most praiseworthy work in beginning a course of lectures by Dean Bryant of the College of Law, on law for engineers. The students in engineering will be given lectures by him on the law of corporations, the law of contracts, etc. Dean Bryant does this free of charge to the engineering students, who will doubtless show their high appreciation of his generosity by attending every lecture.

PERSONAL.

SCHUYLER S. WHEELER, Sc. D.[1]

Schuyler S. Wheeler, Sc. D.

Dr. Schuyler S. Wheeler, the electrical expert, Board of Electrical Control of New York City, and president of the well-known firm of the Crocker-Wheeler Electrical Company, was born in New York City, May 17, 1860. He is the son of James E. Wheeler, of Waterloo, N. Y., and Amrie W. Wheeler, his wife. He was prepared for college at the "Friends' Seminary," Keble Hall, and Columbia Grammar School, and was graduated from Columbia in 1881. Since leaving college, Hobart College has conferred on him the honorary degree of Doctor of Science.

Dr. Wheeler has written numerous papers on electrical engineering; and two supplements to *Harper's Weekly* on "Electrical Lighting." He is also in part author of the standard work entitled "Practical Management of Motors and Dynamos" (Crocker & Wheeler, 8vo.; D. Van Nostrand & Co., 1892). He has been vice-president of the Civil, Mechanical and Electrical Engineers Societies, and is also a member of the National Electric Light Association.

Dr. Wheeler is in politics a Mugwump, and is a member of the University Club.

Upon leaving Columbia College in 1881, Mr. Wheeler became assistant electrician of the American branch of the Jablochkoff Electric Light Company. When that company dissolved, he joined the United States Electric Lighting Company, and subsequently left them to become a member of Mr. Edison's staff.

Mr. Wheeler was present at the inauguration of the Pearl Street Edison Station, was made electrician in charge, and was detailed to lay the underground systems in other cities.

He afterwards became superintendent of the Newburgh Edison Company, resigning that position to accept the post of electrician to the Herzog Teleseme Company. Mr. Wheeler subsequently joined the C. & C. Electric Motor Company as electrician and factory manager. After establishing the large factory of this company, he accepted the appointment of Electrical Expert of the Board of Electrical Control of New York, an important official position in which he has been called upon to superintend the removals of all the overhead wires in the city, a work which has taken over four years, and has been much talked of in the papers. During this time about 50,000 miles of wire and 8,000 poles have been removed. He has also been called upon to make expert examinations and reports for the city upon all cases of electrical accident.

PROF. E. J. HOUSTON.

At the last meeting of the New York Electrical Society, Prof. E. J. Houston, of Philadelphia, was elected an honorary member in recognition of his long and eminently successful and useful career in the field of electricity.

Mr. W. T. Mottram, of Dallas, Tex., and for a long time agent in the South-West for the Edison and General Electric interests, has removed to New Orleans and has been appointed electrical engineer of the New Orleans Traction Company, which is about to undertake a large amount of trolley line construction, beginning probably with its Prytania street branch. Mr. Mottram is a young engineer of unusually ripe experience, and well qualified for his new work.

Mr. A. Mitchell Hall, heretofore in the sales department of the C. & C. Electric Motor Company, of New York, has now assumed the position of general manager of the company.

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[1] *University Magazine*, Feb. 1893.

LETTERS TO THE EDITOR.

SUGGESTIONS FOR THE INTERNATIONAL ELECTRICAL CONGRESS AT CHICAGO.

Certain amendments to the Report of the Special Sub-Committee of the American Institute on Provisional Programme for the International Congress of 1893, should, it seems to me, be made. Referring to the programme issued by the Institute, page four now reads: "The value of the practical unit of illumination to be a bougie-decimale at the distance of one metre. The bougie-decimale is the unit of light and power already established, and is practically equal to one English Standard Candle." Page five: "For the practical unit of illumination defined above the name bougie-metre."

The first part of this being already established, ought probably to stand, but the second part, that quoted from page five, ought, it seems to me, to be changed to read "For the practical unit of illumination defined above, the name 'Davy.'" Davy was the first discoverer of electric lighting properly so called; has a short name, and was known and honored by all nations; his name is, I conceive, much more appropriate than "bougie-metre" which is clumsy.

On page nine the clause now reading, "The north pole of a magnet to be defined as being that which seeks the geographic north pole, and the south pole that which seeks the geographic south pole," is incorrect and requires change. I think the following would be better: "The north pole of a magnet to be defined as being that which in a magnet poised to swing freely in a horizontal plane seeks the terrestrial north magnetic pole,, and the south pole that which seeks the terrestrial south magnetic pole."

I consider that the proposed use of the term "voltage" in place of the terms potential, tension or pressure, and as a synonym, would not be an improvement; for why should we name a magnitude in terms of its unit? Or, if in one case, why not in other cases also, calling resistance "ohmage," current "amperage," and quantity "coulombage," thereby becoming consistent? Besides, electromotive force and difference of potential are not always interchangeable terms, both, however, being measurable and expressed in volts.

On the same page the proposal to substitute "continuous current" for "direct current" I consider should not be complied with. It gives no idea of direction, but does give the idea of continuity. If it should be adopted generally, a rapidly intermitting current, that is to say, a discontinuous current would be called a "continuous current" provided it was of uniform direction. I do not think the term "direct current" is beyond criticism, but it is better than its proposed substitute.

T. D. Lockwood.

Boston, Mass., Jan. 27, 1893.

IS LIGHTNING A CAR ARRESTER?

In your issue for Nov. 16, '92, Vol. XIV, No. 237, p. 480, Mr. Alex. Jay Wurts says:

> "In many of our cities and towns, particularly in the Western sections of the country, it has been common practice during thunder storms to shut down the plant, pull down the trolleys and wait till the storm shall have spent itself. In one case, with which I am familiar, the direct losses from enforced idleness during thunder storms amount to over $6,000 per year."

The above statement has been copied in the English journals, and it would be of interest to know something of how far such practice *is* (?) or *has been* (?) *common.* Who will give names of roads, make of apparatus and detail of delays per year? The information would certainly be of interest.

J. Stanford Brown.

New York City, Feb. 9, 1893.

SOCIETY AND CLUB NOTES.

SUBURBAN UNDERWRITERS' ASSOCIATION.

At the meeting of the Executive Committee of the Suburban Underwriters' Association, held on Tuesday, Feb. 7, Mr. Fremont Wilson was appointed as consulting electrician for said Association. Rules governing the installing of electric light, heat and power installations have been recommended, and are the same as those recommended by the United Association of Underwriters' Inspectors, of which Mr. C. M. Goddard, of the New England Exchange, is secretary. The territory at present under the jurisdiction of this Association is Queens, Suffolk, Westchester, Putnam and Rockland counties. Richmond County is practically under the jurisdiction of the Association, and the same rules and regulations will undoubtedly be required there. Any information which parties may desire will be furnished by Mr. H. E. Bowers, secretary of the Association, 44 Pine street, New York City.

BADGES AT THE ST. LOUIS CONVENTION.

THE distinguishing badges to be worn by the officers of the N. E. L. A. at St. Louis have been announced as follows:

President, gold button, red bow; officers, Association button, silver, red bow; executive committee, same button, blue bow; active members, same button, purple ribbon; associate members, same button, violet ribbon; honorary members, same button, white ribbon; reception committee, same button, yellow ribbon; guests, olive ribbon.

LITERATURE.

De Magnete. By William Gilbert, M. D. Translated by P. Fleury Mottelay. *New York*, John Wiley & Sons, 1893. XLV +, 368 pp. 6 x 9 inches. Cloth. Price, $4.

IN our issue of January 18, we reviewed this work from the advance proofs kindly furnished us by the publishers. The complete volume is now before us and to our commendations for the work of the translator, already expressed, we must now add our avowal of admiration at the style in which the publishers have submitted the work to the reading public. The letter press is printed on heavy book paper, in large type, and all the engravings are reproduced in fac-simile and full size from the original issue of 1600. Additional interest is afforded by the fac-simile reproductions of the title pages of the 1628 and 1633 editions of the De Magnete, and of the posthumous "De Mundo Nostro Sublunari" of Gilbert, which have been embodied at the end of the work.

The book is beautifully bound in white cloth with gilt top, and bears the arms of Gilbert in gilt on the front cover. From both a scientific and an artistic standpoint, this translation of De Magnete is in every way worthy of its great author.

Electrical Experiments. By G. E. Bonney. *London & New York;* Whittaker & Co., 1893. 252 pp. 5 x 7 inches. Cloth. Price, 75 cents.

THIS book is intended as a guide to young experimenters who desire to make their hours of amusement profitable. It describes in clear language, accompanied by numerous illustrations, a large number of simple electrical experiments, extending over the whole range of applied electricity.

How To Manage the Dynamo. By S. R. Bottone. *New York;* Macmillan & Co., 1893. 63 pages 5 x 7 inches. Cloth. Price, 60 cents.

THE author has sought to give dynamo attendants plain directions as to the management of their machines, and the location and remedy of troubles. So far as the latter is concerned this part has already been done better in previous publications.

OBITUARY.

GEO. B. PRESCOTT, JR.

IT is our sad duty to record the death, on Feb. 12, of Mr. Geo. B. Prescott, Jr., after an illness of nearly a year and a half. He was the eldest son of Alphonso and Harriet A. Prescott and a descendant in the eighth generation from James Prescott who came from Dryby, Lincolnshire, England, and settled in Hampton, N. H., in 1665. He was born at Pittsfield, Mass., in 1858, a year in which his parents removed with him to Milwaukee and afterward to Ottawa, Ill. His father enlisted in the War of the Rebellion, was made lieutenant of the 104th Illinois Volunteers, and was captured by Morgan's Guerrillas. After these stirring episodes the family settled in St. Louis, where George B. remained until he came to New York in 1876, when, through the influence of his uncle, George B. Prescott, a prominent electrician in the service, he became connected with the Western Union Telegraph Company under such an admirable instructor as George A. Hamilton, while Mr. F. L. Pope gave him lessons in drawing, in which he became quite expert. Mrs. Pope noticed his ability and encouraged him in the study of mathematics. In 1880 Mr. Prescott resigned his position with the Western Union and entered the laboratory of Mr. Edward Weston, at Newark, N. J., where he assisted actively in the varied pioneer work on dynamo, arc light and incandescent lamp construction then being so diligently prosecuted by Mr. Weston; and quite a number of patents issued to Mr. Prescott date from that period. Mr. Prescott had from the beginning devoted special attention to the storage battery, with the result that in 1889 The Electrical Accumulator Company, offered him the position of electrician to the company, which he accepted and held until early part of 1891, when he assumed the agency for A. G. Day, manufacturer of "Kerite" wires. It should be mentioned that in 1887-8 he fitted up and operated the pioneer electric car of the West End Company of Boston.

Up to 1891 Mr. Prescott had been engaged in purely professional work but the sudden assumption of duties involving large business and financial responsibilities appears to have borne very heavily upon one who had always been of a highly nervous disposition. The result was a nervous prostration which compelled Mr. Prescott to abandon all business for a while. In order to fully recover his health he removed to Pittsfield, Mass., and returned for a short while to professional work in the Stanley Experimental Laboratory; but continued ill health induced him to seek the milder climate of Bermuda. Unfortunately the sought-for improvement did not take place, and when Mr. Prescott returned a few weeks ago it was only too apparent that he was beyond recovery.

Naturally quick of perception, Mr. Prescott possessed that rare quality which coördinates facts and by which he was enabled to employ his knowledge to the best advantage. He was a frequent contributor to THE ELECTRICAL ENGINEER and other electrical and lay journals, and was the author of the well-known Copper Wire Table published by Messrs. Holmes, Booth & Haydens, which passed through numerous editions.

Mr. Prescott was from the beginning prominently connected with the American Institute of Electrical Engineers and was a member of its council for a number of years. He was also a member of the Standard Wiring Table Committee of the Institute, a large part of whose report embodies his work and research. In 1888 Mr. Prescott was married to Miss Frances Russell Cooley, of Pittsfield, Mass., who survives him.

COST OF MUNICIPAL ELECTRIC LIGHTING

IN the course of an article entitled "Electric Street Lighting in American Cities," in the February *Review of Reviews*, Mr. R. J. Finley says: "The average cost of each arc light owned and directly operated by twenty-five cities is $53.04 a year. In the case of only three or four of the cities, does it appear that interest on the investment has been included. Obviously, account should be taken of both interest and depreciation of property, which items, computed at twelve per cent. of the total value of the twenty-three plants and buildings, would add $33.60 to the first cost, making the average final cost to the twenty-three cities operating electric lighting plants $86.64 per arc light per year.

There is one important factor that has not been considered in this cost, namely, the profits which many of the cities receive from light supplied to private and commercial houses. Eighty dollars per light per year will be found to be much nearer the real cost of municipal electric lighting in the United States if the receipts from commercial lamps are deducted.

THE WORLD'S FAIR "SCRIBNERS."

CHARLES SCRIBNER'S SONS are preparing a novel and interesting contribution to the World's Fair in the form of an "Exhibition Number" of *Scribner's Magazine*, to be published simultaneously with the opening of the Exposition at Chicago. They have planned to make it as fine an example of an American Magazine as can be produced by a house to whom the best literary and artistic resources are open. It is not proposed that the text shall relate chiefly to the Fair, but, on the contrary, the leading writers and artists have been asked to contribute to the number what they themselves think will best represent them. The pages of text and illustration will be largely increased.

THE CHICAGO EXHIBITION.

MR. H. D. WILKINSON has been appointed engineer to the British Section of the Chicago Exhibition, and will sail on or about the 20th prox. Mr. Wilkinson is "an old Exhibition hand." At the Paris Exhibition of 1889 he was in charge of Messrs. Davey, Paxman & Co.'s exhibit, in 1891 he was responsible for the electric lighting of the Naval Exhibition, and at the Crystal Palace Exhibition of last year Mr. Wilkinson also held an important post.

THE TROLLEY ON THE ERIE CANAL.

A BILL has been introduced in the New York Legislature by Mr. Rice, authorizing Sherman Petrie of Kings County to use the Erie Canal to experiment with the trolley electric system as a motive power for canal-boats, the experiments to be made at Mr. Petrie's expense, under the supervision of the State Superintendent of Public Works.

WESTERN OPINION.

A READER in Iowa writes: "I have taken THE ENGINEER for several years and consider it the best in its line."

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED FEBRUARY 7, 1893.

Conductors, Conduits and Insulators :—

Telephone Cable, S. W. Holman, Boston, Mass., 491,109. Filed Nov. 5, 1892.

A cable composed of two or more twisted pairs of conductors, each pair having a twist of different pitch from that of any adjacent pair.

Insulator Clip, W. H. Edmunds, New York, 491,208. Filed Aug. 9, 1892.

A semi-circular clip adapted to half surround the insulator and having wedge-shaped hooks at the ends for the reception of the line wire.

Insulator, A. R. Lane, New York, 491,362. Filed May 18, 1892.

Consists of two insulating blocks between which the wire is held, supported in a metal frame and having a screw pressing upon the upper block.

Method of Insulating Electric Conductors, T. E. Morford, Chicago, Ill. Reissue. 11,303. Filed June 8, 1892.

Employs an enamel of non-conducting material imbedding the conductors.

Dynamos and Motors :—

Bipolar Electrical Machine, T. H. Hicks, Detroit, Mich., 491,106. Filed Feb. 8, 1892.

Employs field magnets wound with two sets of coils, one set in series with the external working circuit which is supplied with alternating currents, and the other set of coils on the field magnets supplied with currents direct from the armature; both sets acting mutually to maintain the field of force.

Dynamo Electric Machine, G. V. M. A. Parrot & A. C. Reignier, Paris, France, 491,294. Filed Aug. 8, 1892.

Employs an armature constructed of strips, each composed of a rod of iron and one of copper, superposed upon another.

Electrical Transmission of Power, C. S. Bradley, Avon, N. Y., 491,465. Filed Apr. 4, 1892.

Invention relates to the transmission of continuous currents over long distances, and consists in placing a large number of generators in series thoroughly insulated from one another and from the earth, and transmitting the combined electromotive force of all the machines to line.

Insulation of Dynamo Armatures, T. E. Morford, Minneapolis, Minn., 491,490. Filed Jan. 28, 1891.

Employs an insulating enamel adhering to the core and imbedding the coils.

Heating :—

Electrically Heated Soldering Iron, S. B. Jenkins, Boston, Mass., 491,311. Filed June 8, 1892.

Electrically Heated Smoothing Iron, S. B. Jenkins, Boston, Mass., 491,312. Filed June 8, 1892.

Electric Curling Iron Heater, S. B. Jenkins, Boston, Mass., 491,313. Filed June 8, 1892.

Hat Brim Softening Device, W. Mitchell, Malden, Mass., 491,319. Filed June 8, 1892.

An electrically heated device for use in the manufacture of hats.

Electrical Water Heater, W. Mitchell, Malden, Mass., 491,320. Filed June 18, 1892.

Electrically Heated Vessel, W. Mitchell, Malden, Mass., 491,321. Filed June 8, 1892.

Electrically Heated Gridiron, W. Mitchell, Malden, Mass., 491,322. Filed July 2, 1892.

Electric Metal Heating Device, W. Mitchell, Malden, Mass., 491,437. Filed June 16, 1892.

Electrically Heated Muffle, W. Mitchell, Malden. Mass., 491,438. Filed July 5, 1892.

Electrically Heated Vessel, S. B. Jenkins, Boston, Mass., 491,484. Filed June 9, 1892.

Measurement :—

Electrical Measuring Instrument, E. G. Willyoung, Philadelphia, Pa., 491,457. Filed Aug. 11, 1892.

Claim 18 follows:

In a measuring instrument for measuring electrical currents, the combination of an expansion wire, a pointer actuated thereby, a compensating support for the expansion wire having its ends provided with means for holding the wire in tension, and an intermediate frame for sustaining the support of the wire.

Miscellaneous :—

Retouching Device, A. S. Harry, Steubenville, O., 491,171. Filed Nov. 15, 1892.

Electric Clock, J. H. Dyson, Belleville, Wis., 491,339. Filed June 6, 1892.

Electro-Mechanical Movement, E. Gray, Highland Park, Ill., 491,345. Filed Jan. 8, 1892.

Electric Lock, O. A. Moyer and H. W. Rhodes, Ogden, Utah, 491,369. Filed April 9, 1892.

Process of Electrically Reducing Aluminum and Forming Alloys Thereof, T. L. Willson, Brooklyn, N. Y., 491,394. Filed March 25, 1891.

Combined Electric Switch and Door Lock, J. H. L. Holcombe, U. S. Navy, 491,426. Filed Oct. 24, 1892.

Insulated Magnetic Coil, T. E. Morford, Minneapolis, Minn., 491,491. Filed Jan. 28, 1891.

Employs an enamel imbedding the coil.

Resistance Box, E. Weston, Newark, N. J. Design, 22,207. Filed Sept. 10, 1892.

Lamps and Appurtenances :—

Electric Arc Lamp, W. E. Freeman, Long Island City, N. Y., 491,095. Filed July 8, 1892.

Claim:

The combination with the spools, the rocking frame and the cores, of the clutch levers, embracing the carbon carrying rod, and the cam on the rocking frame, whereby the levers are operated.

Arc Light Carbon, J. McLaughlin, Chicago, Ill., 491,124 Filed May 5, 1891.

A carbon consisting of a plurality of separated members integrally joined at one end.

Duplex Electric Arc Lamp, C. E. Scribner, Chicago, Ill., 491,251. Filed Oct. 20, 1890.

Employs upper carbon rods adapted to move in unison and lower carbons one of which is fixed and the other movable and controlled by an electro-magnetic device in circuit with the fixed carbon holder.

Lamp Socket, E. R. Elliott, Litchfield, Ill., 491,268. Filed March 28, 1892.

A key operated by an endwise movement of a shaft across the lamp socket.

Railways and Appliances :—

Inclosed Conductor for Electric Railways, F. C. Perkins, Dunkirk, N. Y. 491,182. Filed May 27, 1892.

An insulated supply conductor for traveling contact enclosed in an elastic metallic tube adapted to be compressed by the traveling contact to establish electric connection with the conductor.

Trolley Stand, S. Harris, Cleveland, O., 491,210. Filed Nov. 14, 1892.

Consists of a stationary base provided with an upright hub, a housing having a sleeve concentric with the hub, and an inner loose sleeve with a series of anti-friction rollers in the annular chamber between the inner sleeve and the hub.

Electric Railway Trolley, B. Kochs & A. Kochs, St. Louis, Mo., 491,361. Filed July 25, 1892.

A reversible trolley pole carrying two trolleys swiveled upon the pole in such a manner as to be capable of a vertical oscillatory movement independent of the yoke which carries them.

Electric Circuit for Railway Signaling, L. Thaler, New York, 491,337 Filed Aug. 24, 1892.

An electric block system for steam railways.

Switch for Electrical Tram Cars, M. Immisch, London, Eng., 491,483 Filed Nov. 21, 1891.

A self-locking switch for street railways.

Telegraphs :—

Printing Telegraph Receiver, M. D. Porter, Brooklyn. N. Y., 491,133. Filed Dec. 10, 1891.

Vibratory Telegraphy, S. D. Field, Yonkers, N. Y., 491,163. Filed Jan. 7, 1892.

Claim 1 follows:

The combination of a local circuit including signal transmitting device, a line circuit and low and high tension coils connected to the respective circuits, said coils being in inductive relation to the magnetic system of a continuously operating dynamo electric machine.

Telautograph, E. Gray, Highland Park, Ill., 491,347. Filed Sept. 21, 1892,

Claim 1 follows: The combination of a motor, a telautographic receiving pen driven thereby, and a magnetic clutch through which the power of the motor is transmitted to the driver mechanism, said clutch consisting of two members each of magnetizable material, one having a rotary and the other a rectilinear action.

Telephones and Apparatus :—

Testing Apparatus for Multiple Switchboard Systems, C. E. Scribner Chicago, Ill., 491,250. Filed Sept. 9, 1890.

Employs a pair of loop plugs and cords, and branch from the strand of the cords, connecting the sleeves extending through the winding of the clearing-out annunciator.

Metallic Circuit for Multiple Switchboard Systems, J. A. Seely, New York, N. Y., 491,252. Filed Nov. 15, 1886.

Invention consists in placing the different magnets of each of the clearing out rods in different strands of the cords, so that the resistance of the two sides of the metallic circuit may be balanced.

Telephone Transmitter, H. L. Tyler, Corning, N. Y., 491,275. Filed May 13, 1892.

Employs a non-conducting diaphragm having a hook secured to it and a carbon chain connected to the hook, the chain being not only a conductor but from its link construction adapted to vary the intensity of the current flow.

Multiple Switchboard System, C. E. Scribner, Chicago, Ill. Reissue. 11,306. Filed Nov. 6, 1891.

Employs a retardation coil in a ground branch extending from one side of the metallic circuit.

THE PREPARATION OF INCANDESCING FILAMENTS.

ACCORDING to the *Zeitschrift für Electrotechnik*, the Buda-Pesth Incandescent Lamp Company have introduced some important modifications into the manufacture of incandescent lamps. The uncarbonized filaments of wood, cotton or other vegetable fibre are first immersed in a bath containing 25 to 30 per cent. of potassium silicate, 10 to 15 per cent. of gum arabic, and 12 to 13 per cent. of caustic soda. After removal they are rolled to the section of an angle iron which is said to give a strong filament with a considerable surface. The filaments are then carbonized, after which they are mounted and placed in a bath of melted paraffin or naphtaline. After the latter has become solid by cooling, a current is passed through the filaments, melting and vaporizing the paraffin in their immediate neighborhood, and causing a deposit of carbon, as in ordinary flashing. It will be seen, however, that by this method the carbons can be standardised before being placed in their bulbs. Liquid paraffin is said not to work, as convection currents are then established in the bath, which bring all the oxygen entangled in the bath in contact with the filaments, sparking them. The solution in which the filaments are soaked before carbonizing is said to protect them during carbonization, and to give them a uniform surface, on which carbon can be deposited during the flashing process. The gum arabic is also beneficial, the filaments being stronger after carbonization when it is used. When the resistance of the filaments has been brought to the proper point by the flashing process, they are removed from the bath, and any excess of paraffin or naphtaline sticking to them is washed off with alcohol.

A TELE-TYPEWRITER TOURNAMENT.

A FAST-SENDING and typewriter-receiving telegraph tournament will be held in Hardman Hall, this city, on March 11. The contest will be divided into several classes and several prizes in money are offered. For the championship of the world a medal, valued at $200, will be given. The entrance fee has been fixed at three dollars for each class.

Communications should be addressed to W. S. Williams, secretary, care of the Postal Telegraph Company, 187 Broadway, New York city.

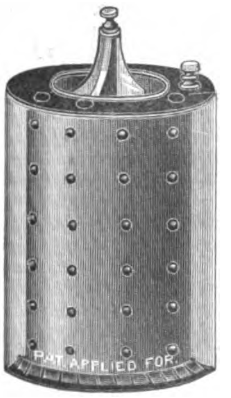
THE FRENCH PACIFIC CABLE.

THE French Ministry, at a council held at the Elysee on February 4th, approved the proposition to lay a cable from the French colony of New Caledonia to Australia.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE PREMIER-DE MOTT BLUE STONE BATTERY.


PAT. APPLIED FOR.

The Premier-De Mott Blue Stone Battery.

THE accompanying engraving represents a new type of blue stone battery just brought out by Mr. M. R. Rodriguez, of 17 and 19 Whipple St., Brooklyn, N. Y. This battery is intended for operating electric devices for long periods of time, Type "A" 5 x 7 inches being adapted for driving electric fans, turn-tables, etc., and Type "B," 6 x 8 inches, for telegraph or signal work.

The cells are furnished with a special zinc which forms no hard coatings, so that they can be readily cleaned with a piece of cloth. The zincs, it is claimed, will last 1,500 hours and need not be taken out of the solution.

These cells have run the No. 3 Premier motor for 200 hours, night and day, and 400 hours at ten hours a day, at a total cost of less than 50 cents.

Mr. Rodriguez also manufactures the Premier cell adapted to be used in connection with bichromate solutions of all kinds, and having 70 ampere hours capacity at two volts. Two such cells will run a 1 c. p. incandescent lamp for 30 hours at a cost per charge of 6 cents.

THE DELAWARE HARD FIBRE COMPANY.

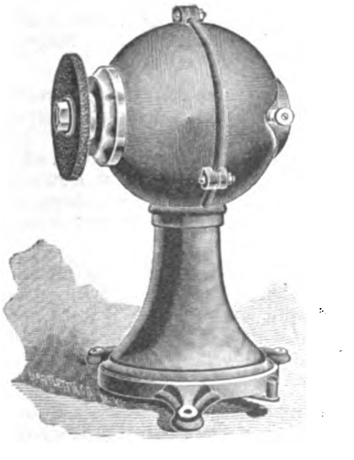
THE "hard fibre" made by the Delaware Hard Fibre Company, of Wilmington, Del., is a vegetable substance closely resembling horn in structure. It possesses the strength and density of a metal and yet is elastic and nearly as light as hard wood. It is insoluble in any of the ordinary solvents and is unaffected by contact with alcohol, ammonia, turpentine or the animal, vegetable or mineral oils. When immersed for some time in water it will absorb it and swell, but is in no way injured, and upon drying it resumes its former size and density.

An important property of hard fibre is that when pure and dry, it is an excellent insulator. This fact, in connection with its physical properties adapts it for many uses in electrical construction. It may be sawed, worked in a lathe or planer, riveted, punched, drilled and tapped and will take a fine polish, in addition to which it is not brittle but on the contrary very tough, and will stand a great amount of pounding and rough usage.

A noteworthy feature of this material is that it improves with age. For electrical work fibre that has been cured for six months or a year gives the best results.

The uses to which this substance is applicable are many, and the company, in their new catalogue, show scores of different devices, among which are insulators, brush holders, switch handles, fuse blocks and others of especial interest to electricians.

SMALL LUNDELL MOTOR AND EMERY GRINDER.



Lundell Motor and Emery Grinder.

THE fact that the small, as well as the larger sized Lundell power motors manufactured by the Interior Conduit and Insulation Company, of New York, have been and can be adapted to many useful purposes, is again exemplified in the new bench emery grinder which this company has just standardized. The accompanying cut illustrates this neat little machine, which will at once commend itself to machinists and others interested in the grinding of small tools, such as twist drills, lathe tools, graving tools, knives, scissors, etc. All shops that have adopted electric illumination can conveniently use this device. The emery grinder illustrated is 12 inches high, weighs 18 lbs., operates at a speed of 2,500 revolutions maximum, and has in its base a regulating device for two lower speeds. It is of $\frac{1}{6}$ h. p. capacity, 115 volts and swings a two-inch emery wheel. Larger and smaller wheels driven by motors of higher or lower powers, are also furnished by the same company.

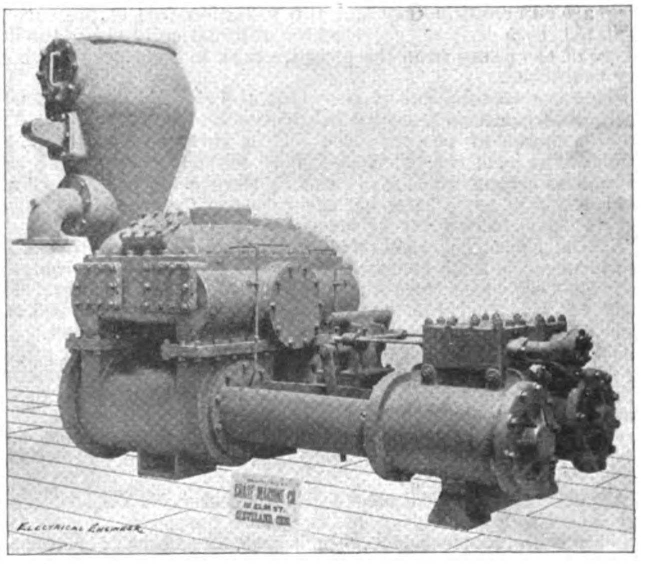
PROGRESS IN ELECTRICITY BUILDING, WORLD'S FAIR.

IN the electrical building the Western Electric Company has partially completed a handsome gothic pavilion in which an attractive exhibit will be made. One of the features will be a long distance telephone, connected with a high sounding board through which concerts given in New York and other distant cities can be enjoyed by visitors in the amphitheatre in which the instrument will be placed. Next to this pavilion the Bell Telephone Company and the Edison Company and the telegraph companies will put up handsome booths to show the development of the telephone, telegraph and electrical apparatus generally.

THE CHASE CONDENSER PUMP.

THE CHASE MACHINE COMPANY, of 111 Elm street, Cleveland, O., are furnishing the Detroit Electric Light & Power Co. a condenser pump, the steam cylinders of which are 12 inches diameter 15 inches stroke. The cylinders are 15 inches diameter by 15 inches stroke, and the weight of the machine complete, is 10,150 pounds. The piston rods are 1¾ inches in diameter of solid Tobin bronze. The air or heater cylinders have cast composition, reversible levers, composition valve seats and pins, and hot water rubber valves.

The water pistons are arranged for packing with six rings of ¾ inch square hydraulic packing, and are easily reached from the back end of the cylinders by removing the cylinder heads and piston followers. The spray is self-cleaning, or rather is operated from the outside of the vacuum chamber, and is said to be unique in this respect. The steam end of this pump is similar to those of other well-known machines, as the accompanying engraving shows.



CHASE CONDENSER PUMP, DETROIT ELECTRIC LIGHT AND POWER COMPANY'S PLANT.

A NEW ISOLATED PLANT FOR ST. LOUIS.

THE Consolidated Engineering Co. with offices in the Security Building, St. Louis, secured the contract last week for the entire installation of the new arc and incandescent plant to be placed in the Globe Clothing & Shoe Company's establishment. The arc lighting portion goes to the Standard Electric Co. of Chicago, and consists of two 40-light machines, while two 400 light direct current machines will be furnished by the National Electric Manufacturing Co. of Eau Claire, Wis. Power will be furnished by two 108 h. p. Russell engines. When completed, there will be no better lighted store in the country. Some novel features in lighting will be introduced by the Consolidated Engineering Co. in the installation of this plant.

CARPENTER HEATERS FOR A STEAMER.

THE CARPENTER ELECTRIC HEATING MANUFACTURING COMPANY of St. Paul, Minn., D. Richardson, general manager, reports that it is in receipt of an order from the American Steel Barge Company, West Superior, Wis., for a complete equipment of electric cooking utensils for the new whaleback World's Fair passenger steamer "Columbus." The order was given after a careful examination and test of the apparatus. The steamer will be the first ever equipped with electric cooking appliances.

GOULD TRIPLEX PUMPS.

AMONG the recent installations of Triplex power pumps, by the Gould Manufacturing Co., of Seneca Falls, N. Y., is one just installed in the Fireman's Insurance Building, Baltimore, Md., by Messrs D. E. Evans & Co., of that city.

The problem for solution was the operation of an Otis hydraulic passenger elevator, which had been formerly run by city water, by means of an electrically operated pump. The plant consists of a 15 h. p. Thomson-Houston motor belted to an 8-inch x 8-inch triplex pump which maintains a pressure of 80 lbs. in a 1,500-gallon pressure tank, the control of the motor and pump being effected by a Clark regulator furnished by the General Electric Co. The pump is speeded at 40 revolutions per minute and maintains a uniform pressure of 80 pounds in the pressure tank, and upon the starting of the elevator, the regulator is so nicely adjusted that the pump and motor start with a variation of a few pounds from the normal pressure.

From the data collected regarding the power, consumption, etc., it is calculated that the power for ten hours a day for a month, does not exceed five to six h. p., a very economical rate for operating an electric elevator for office buildings, and the apparatus is so arranged that in case of a break-down at the power station, the city water can be instantly turned on and the elevator run by its pressure until electric energy is again supplied.

At A. Schwartz & Son, New Orleans, is another very complete electro-hydraulic pumping plant, consisting of two hydraulic passenger elevators for a building five stories high. The pumping plant consists of one 8-inch x 10-inch triplex pump operated with 25 h. p. Eddy motor maintaining a pressure of 80 pounds in a 3,000 gallon pressure tank. In this plant the motor and pump are run continuously and the variation in the pressure is regulated by a by-pass valve which automatically shifts the discharge of the pump from the pressure tank to the waste tank as may be desired.

Since the installation of the plant, the elevators have been in continuous operation from ten to twelve hours per day. The actual amount of power consumed in this plant is 16¼ h. p., which at the local rate of power cost makes a very cheap and economical arrangement for operating the elevators. A very unusual work is performed by the pressure tank, in blowing a whistle three times a day by means of the accumulated air.

At the Fulton Worsted Mills, Fulton, N. Y., two 8-inch x 12-inch pumps are be to operated with 15 h. p. motors for supplying the mills with water from a source some 25,000 feet distant. The plant is so arranged that the pump and motor can be stopped and started automatically from the mill when occasion requires.

Ordinarily the pumps will be in continuous operation, pumping direct to tank for mill supply. In the cost of installation and operation of this style of pumping outfit, as compared with a complete steam pumping appliance with the necessary attendance, is very largely in favor of the electrical pumping plant. It is so arranged by means of clutch couplings that either one or two pumps can be operated.

At the state industrial schools, at Rochester, N. Y., is another very interesting application of electrical pumping. From two artesian wells 200 feet deep, 6 inch bore, 50 gallons of water per minute are raised by means of power working head operated with electric motors. The water is lifted the 200 feet and then forced into a pressure tank against a pressure of 80 pounds per square inch. The pumps and motors are run continuously and when a normal pressure of 80 pounds is obtained in the pressure tank, an automatic arrangement consisting of a by-pass valve is put in opertion which shifts the water from pressure tank to suction, thus consuming little or no power in operating the pumping mechanism when tanks are filled.

Possibly one of the largest and most extensive electric pumping plants will be installed at the water works of San Antonio, Texas. This plant consists of three 10-inch x 12-inch triplex power pumps, each operated with a 30 h. p. C. & C. motor; the combined capacity being 2,000,000 gallons per 24 hours. The water is taken from four artesian wells 8 inches in diameter and 2,500 feet deep having a combined capacity of 4,000,000 gallons per day.

From the pumps, the water is discharged through a 22 inch main into a reservoir situated three miles distant and to a vertical height of 195 feet above the pumps. At present the electric power is generated in the local power station of the town, but ultimately when the total water supply of the town is installed, which will be 10,000,000 gallons per day, the electric power will be generated by water-wheel situated three miles distant from the pumping station. The motors are geared directly to the pumps and are arranged with such automatic devices as are necessary to run the machinery at any desired speed to meet the varying requirements of the city's supply.

At Portland, Oregon, there are probably in use more electric hydraulic pumping plants than in any other city in the country. Among the most notable installations is that in the Oregonian Building. At this place one 10-inch x 12-inch triplex power pump operates two large passenger elevators, two side-walk lifts and one freight elevator. The pump discharges into a 3,000 gallon pressure tank, maintaining a uniform pressure of 100 pounds per square inch.

The motive power is a 75 h. p. Edison motor, which in addition to running the 10-inch x 12-inch triplex power pumps, operates a large Hoe printing press and other machinery connected with the printing outfit. The discharge to the pressure tank is automatically regulated by means of a by-pass valve which is made to shift the water from pressure tank to open tank as the pressure reaches its normal amount. This plant is in operation 24 hours per day and the elevators and other machinery are in constant motion. The plant has been preëminently successful; the consumption of power of the daily running coming within the prescribed limit of the guarantee and the expectations of the engineers.

A similar plant is in operation at the Worcester Building, in which two large passenger elevators for a seven-story building are operated with 10-inch x 12 inch triplex pump in combination with a 40 h. p. C. & C. motor. Here the pump discharges into a 5,000 gallon pressure tank and maintains a uniform pressure of 100 pounds for the operation of the elevators. The average consumption of power for operating these elevators is 18¼ h. p. for the whole day.

WESTERN NOTES.

THE ILLINOIS ELECTRICAL FORGING COMPANY has just been incorporated with a capital of $2,000,000. Walter G. Campbell of San Francisco is president, L. D. Kneeland, vice-president and John P. Skinner, of New York, secretary and treasurer. The offices will be in the Title & Trust Building, No. 100 Washington street, Room 401, Chicago, Ill. This company will do all kinds of electrical forging, smelting and welding, and will be located at West Pullman.

Mr. Campbell, the president, has been interested for the past few years in mining in the far West and has a vast experience with ores. Mr. Kneeland, the vice-president, is also vice-president of the West Pullman Company and a large stockholder.

MR. W. R. MASON, the General Manager of the Railway Equipment Company, Chicago, has just sent out a circular to the eastern trade, calling attention to the unequalled facilities of the company for furnishing everything necessary for the complete equipment and maintenance of electric roads, and also calling particular attention to the merits of the Type "G" overhead material manufactured by his company. This material has been specified on a majority of the leading roads during the last season. He also informs the trade that he expects to be in New York the latter part of this month, and will call on the leading contractors and street roads in the East.

AMONG a number of sales recently made by the Chicago office of the Ball Engine Co., of Erie, Pa., are the following :

Calumet Electric Street Railway Co., Chicago, four 300 h. p. cross-compound electric railway engines ; Hammond Electric Street Railway Co., Hammond, Ind., one 150 h. p. steam plant complete ; H. D. Bentley. Freeport, Ill., one 35 h. p. steam plant complete ; Elmwood Electric Light Co., Elmwood, Ill., one 150 h. p. engine ; Union Passenger Station, Chicago, one 125 h. p. engine ; Keith Bros. & Co., Chicago, one 50 h. p. engine ; Marengo Electric Light Co., Marengo, Iowa, one 100 h. p. steam plant complete ; Scott & Royce, Griggsville, Ill., one 50 h. p. steam plant complete ; Western Light & Power Co., Chicago, one 300 h. p. engine ; Englewood Electric Light Co., Chicago, one 500 h. p. cross-compound engine.

THE CENTRAL ELECTRIC COMPANY are looking about for new quarters in which to house the large stocks of supplies which they purchase, and which their increasing business compels them to carry in order to meet the requirements of their trade and fill their orders with promptness. They report having their eye on several large buildings which will enable them to handle their stock with increased facilities. They have recently added largely to their force, and predict a large trade for the spring.

THE ENTERPRISE ELECTRIC Co., 307 Dearborn street, reports that their local business has increased to such an extent that it has been necessary to secure a delivery truck of their own. In this, as in all the supplies they handle, they wanted the best, and placed their order with Belnap, Esseler & Company, of Detroit, Michigan. The Enterprise Company wish to call the attention of their numerous customers to the fact that they can now guarantee the prompt delivery of all orders.

THE NEW ACME lamp adjuster for regulating the height of incandescent lamps, which is being placed on the market by the Electric Appliance Company, is meeting with a ready sale. The adjusting mechanism, in the form of a rosette, is attached to the ceiling instead of being suspended on the cord, thus giving it a neater appearance and making a more substantial arrangement.

F. G. FULLER, Western sales agent of the U. S. Wire & Cable Company has just closed a large contract with the World's Fair people for rubber insulated cable to be used for power transmission at the World's Fair. This order will amount to about $50,000. There was some spirited competition commensurate with the securing of this handsome order.

THE ELECTRIC APPLIANCE COMPANY report a lively and growing demand for their adjustable electrolier illustrated in another column. They state that, judging from the way the orders come in, it will almost entirely displace the old style cord adjusters.

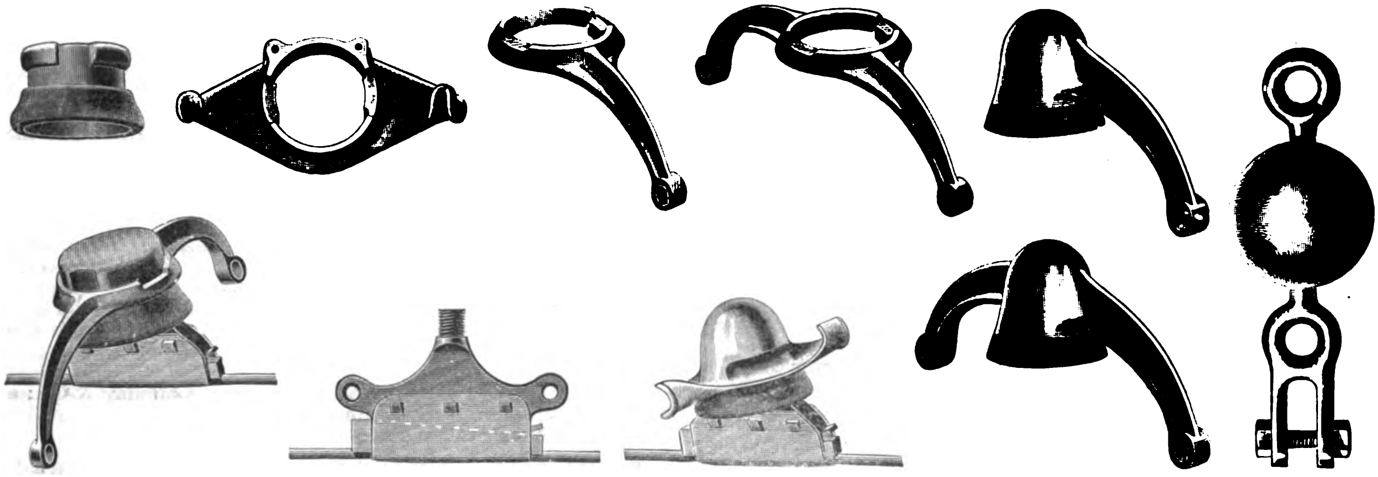
STERN & SILVERMAN.

The new departure made by the above firm of 707 Arch St., Philadelphia, is being noted with a great deal of interest. They will make a specialty of the design and construction of electric railway, light and power plants, a work for which their long years of experience qualify them very thoroughly. Mr. W. A. Stern was for fourteen years connected with the Edison interests, beginning in the employ of Mr. Edison himself at Menlo Park. He then represented the Edison Company in the Pittsburgh district, being prominently connected with the Edison General and General Electric companies, and having charge of the railway department. The firm of Stern & Silverman was formed about three and a-half years ago to develop this work, and made a great success of it, Mr. J. H. Silverman, who has had seven years' in the field, being general manager of the Pittsburgh office for the Pennsylvania General Electric Company.

Under their new auspices, the firm will design and build plants and do expert work. They will not confine themselves to any system or set of apparatus. March 1 they will open their fine store at the above address, carrying a full line of fixtures, chandeliers, etc., occupying also a very large basement and extensive rear building. They know the territory very well, and will push for trade far beyond their old lines.

THE NEW YORK ELECTRICAL WORKS.

The New York Electrical Works, of 161 Washington street, have added to their already long list of specialties for electric railway line construction, and we are now enabled to illustrate certain improved devices not included in the recent article on the same subject in The Electrical Engineer.



Figs. 1 to 10.—Electric Railway Line Material of the New York Electrical Works.

Fig. 1 shows the new universal bell, fitted with $\frac{5}{8}$-inch bushing to fit a mechanical clip or strain-ear. Figs. 2, 3, and 4 represent hangers to fit this bell, making a straight-line hanger, single and double pull-offs. Figs. 6 and 7 show the clip attached. Fig. 5 is a frog pull off.

Figs. 8 and 9 show the insulation moulded into the old forms of straight-line hanger, etc., all in one piece, while Fig. 10 shows a modification of the mechanical clip into a strain-ear.

The advantage claimed for the devices represented by Figs. 1, 2, 3 and 4 is that in case of accident of any kind to the insulation or clip they can be removed and replaced without in the least interfering with the span-wires.

The locking device is a wedge dropped into a slot, and is very simple and effective, while at the same time easily removed without damage.

The Medbery insulation is used exclusively by this company and is giving the most satisfactory results in actual practice.

ACTIVITY AT THE DETROIT ELECTRICAL WORKS.

The Detroit Electrical Works have started in on the spring season in excellent shape and with great activity. They are doing a good trade and making new friends steadily. Some of their recent orders for street railway equipment have been large, including one from the Detroit Citizens Street Railway Company, which has contracted for 60 motor equipments, for its road.

Mr. L. E. Myers, hitherto the special agent for the works at Chicago, has been made District Manager and is to carry out an aggressive policy in developing business in the territory over which he has jurisdiction.

PHILLIPS INSULATED WIRE COMPANY.

Mr. H. C. Adams, the new president of the Phillips Insulated Wire Company, of Pawtucket, R. I., has opened offices at 39 and 41 Cortlandt street, which will hereafter be the headquarters of the company. Mr. Adams's wide experience and acquaintance among electrical business men will greatly add to the strength of the company.

The "O. K." brand of weatherproof insulated wire, manufactured by the Phillips Insulated Wire Company, is claimed to stand the best insulation test, and is made of Lake Superior copper and very handsomely finished.

PROGRESS OF THE CHICAGO EDISON COMPANY.

The Chicago Edison Electric Illuminating Company stockholders have decided to increase the capital stock of $1,500,000 to $3,000,000. This is due to the recently consummated purchase by the Chicago Edison people of the Chicago Arc Light and Power Company. The standing of the Edison Company is very high, its stock being now quoted at 205. President Insull has been East the past week on important business connected with the affairs of the company.

SHAWMUT FUSE WIRES.

We have received advance proofs of a pamphlet to be issued shortly by the Shawmut Fuse Wire Company, of 161 High street, Boston, Mass., which contains some most interesting and valuable information on this important subject. The pamphlet describes the principles governing the action of fuse wire, and shows the necessity of correct proportions in length and diameter to attain proper results. A number of diagrams are given illustrating the points brought out.

HEISLER ELECTRIC COMPANY.

The Heisler Electric Company, Drexel Building, Philadelphia, Pa., contemplate having a strong delegation at the National Electric Light Association meeting on Feb. 28, in St. Louis.

The company has been very busy of late in the manufacture and sale of its standard apparatus. For some time past it has also been at work upon a regulating socket for use on electric lighting circuits, and this it expects to put upon the market very shortly.

"ENERGY."

The advertisement that has appeared recently in our pages, offering the services of a young lawyer who is desirous of making a start in the electrical field is one that deserves notice, and we can heartily recommend companies in need of such talent to communicate with the advertiser. He is a man to be taken up and utilized.

Mr. W. F. Collins, formerly the Western representative of The Electrical Engineer, and now business manager of *The Western Electrician*, has been in New York and the East for several days calling on personal and trade friends. He has met with a cordial reception everywhere, and goes home with bright expectations of even greater prosperity for his progressive journal.

THE SILVEY STORAGE BATTERY FOR LIGHTING CARS AND FOR TRACTION.

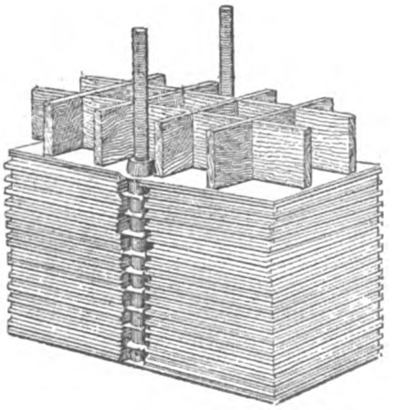
For some time past, passenger cars on the Chesapeake and Ohio and Atchison, Topeka and Santa Fé Railroads have been lighted by current taken from the Silvey storage batteries carried on the cars. According to the *Railroad Gazette*, the first-named road now has in use 30 cars which are lighted in this way. They are all charged at Covington, Ky., and make trips as far as New York and Old Point Comfort. Each car has eight lamps of 16 candle power inside and one lamp on each platform. The accompanying cut shows the general appearence of the battery plates as arranged in a cell.

The battery plates proper consist of a metal grating 6 x 12 inches square, and about ½ inch thick, 21 of which constitute a complete battery cell. These lead plate castings are laid on their sides in a bath, and by an electrical process filled with electrolytically deposited spongy lead, after which they are placed in a bath which hardens the spongy lead into a firm coherent mass; it becomes firmly fixed into the holes and forms a surface layer over the entire plate. The plates are next assembled in proper number to constitute a complete battery. The plates are clamped together by means of a lead screw passing through the hole in the plate as shown, a nut being placed between each two plates, and firmly screwed down. By this means a good metallic contact is made and soldering is unnecessary. In case it ever becomes desirable to take the cell apart, it is easily done by removing these nuts.

The plates are separated by sheets of porous material which has been treated with acids and alkalies, which make it practically indestructible in the electrolyte. The sheets are capable of absorbing more than four times their own weight of the acids used in the battery, which in fact becomes nearly a dry cell, or, in other words, there is very little free liquid to become spilled, and should the rubber cell ever become broken the liquid held in suspension in the separating material is sufficient to operate the lights properly during a trip. In order to prevent any possible splash of the free liquid on top of the battery plates, the cell is made very deep, the plates only filling about half its depth, and as an additional precaution a sort of wooden crate, shown in the cut, is laid on top of the plates, dividing the interior of the cell into small pockets, preventing the formation of waves by any jar of the car.

The cars are all independent of each other, each car being provided with its own batteries, which renders the system very flexible. It has been found in practice that the batteries will light the cars for three nights at one charging so that they are capable of lighting a train through a journey of 2,000 miles. The battery is the invention of Mr. W. L. Silvey and is built by the Dayton Manufacturing Company, of Dayton, O.

The officers of the roads using these batteries are not yet prepared to give detailed statements concerning the cost of the lights. The running expenses have thus far been very reasonable, but, as with all storage batteries, the average cost for any extended length of time depends in large measure upon the cost of renewing the battery, and this is as yet an indeterminate amount for the reason that the first batteries put in have not yet been renewed.



The Silvey Storage Battery.

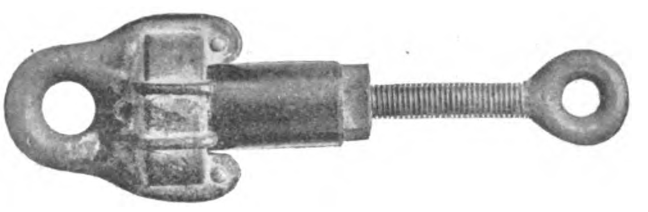
In addition to the above, it may be stated that it is proposed to use the Silvey battery for traction purposes on one or two new electric roads in Ohio.

FORD-WASHBURNE CARS FOR CLEVELAND, O.

We are glad to report, on advices from Mr. C. J. Swift, the business manager of the Ford-Washburne Storelectro Company, that the company has closed a contract with the Woodland Avenue and West Side Street Railway Company for five 30 h. p. street railway equipments of the new flexible connection, single reduction type, one motor to the car.

THE ANDERSON STRAIN INSULATOR.

The accompanying illustration shows the "Brooklyn" strain insulator, manufactured by Messrs. A. & J. M. Anderson of Boston, and recently tested by the Massachusetts Electrical Engineering Company with such satisfactory results. Five of the insulators, submerged for 12 days in salt water were subjected to three tests each. The resistance on the first day was found to range in the five specimens from 160 to 600 megohms; after washing it rose to from 8,000 to 110,000 megohms; and, after drying for ten days, reached 25,000 megohms in the worst specimen and 300,000 megohms in the best. One of the specimens was tested for strength and broke at a load of 7,280 pounds, giving way around the circumference of the iron head.



The Anderson Strain Insulator.

FLOORING THE NORTH RIVER WITH KERITE CABLES.

W. R. Brixey, proprietor of Day's Kerite, Mail and Express Building, has taken a contract to lay two cables each 5,300 feet long from Barclay street, New York, across the North River to Morgan street, Jersey City, for the Metropolitan Telephone Company. They will be 18-conductor submarine telephone cables similar to the seven previously laid by Mr. Brixey for the same company and the Long Distance Telephone Company. These cables are giving fine service, and Mr. Brixey proposes to maintain the high standard of the old work in the new.

PHILADELPHIA NOTES.

Mr. H. S. Buddy, manager of the isolated lighting department of the Penn. General Electric Co., reports a wonderful increase in the business of his department over last year. Among some of the recent important installations are the following: A 75 kilowatt multipolar direct driven machine, 1,500-lights, for both the Bijou Theatre and Hotel Metropole. These machines are a new type and *slow speed*, making but 275 turns. A 1,000-light plant each for the new *Times* Annex and Hensel, Calloday & Co.; a 600-light plant each for Geo. Allen's millinery store, and the City Passenger Railway Co. of Baltimore.

The Heisler Electric Co. report a steady growth in the sale of their long distance incandescent lighting apparatus. Among some of the towns recently adopting their system are the following: Gonzales, Tex.; Seguine, Tex.; Brownville, Tex.; Edwardsville, Ill.; Hanover, Pa.; Lorely, Md.; Chestertown, Md., and Baltimore, Md. They have also installed a 1,500-light combination storage battery plant in the new Provident Building at Fourth and Chestnut streets.

Mr. C. K. Westbrook, formerly with the General Electric Co. and now located at Walnut and Third streets, is offering for sale a patent on a coal cutting machine. The field for coal mining by electricity is very promising. If the machine will do what Mr. Westbrook has claimed for it the patent is a valuable one.

SOUTHERN NOTES.

The Milton Electric Light Company, Milton, Pa., are putting in a 100 h. p. Ball engine, furnished by J. M. Parker & Co., Philadelphia representatives of the Ball Engine Company, Erie, Pa.

The New Castle Steel Company, New Castle, Pa., are placing a 200 h. p. Ball engine, manufactured by the Ball Engine Company, Erie, Pa.

Messrs. S. Bergmann & Co., of Fenn Strasse 21, Berlin, Germany, have issued a profusely illustrated catalogue of interior conduit, fixtures, switches, fuse blocks, etc. The catalogue contains 72 pages and is handsomely gotten up.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

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AN HISTORIC EDISON PLANT.

THE S. S. "COLUMBIA."

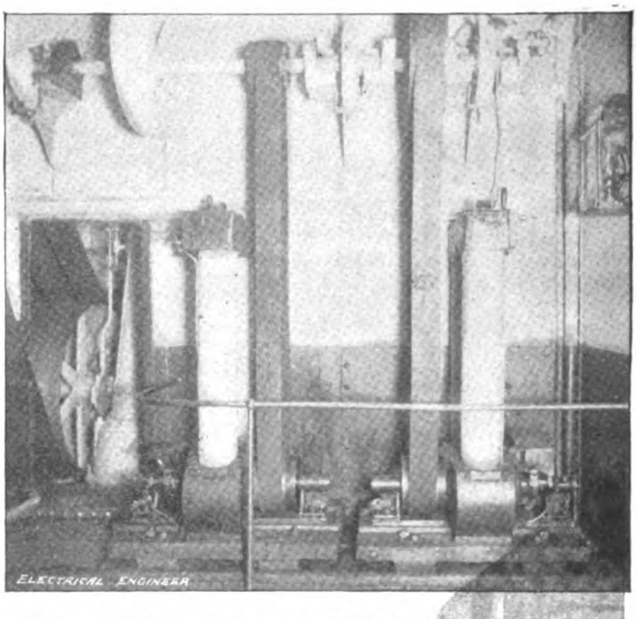
J. C. Henderson.

SHIP lighting by electricity is now a very common and ordinary thing, but time was when the plant installed on board the steamship "Columbia" of the Oregon Railway and Navigation Company was a great marvel. And yet that plant was started as recently as May 2, 1880. It has never been illustrated before, and its story is not very well known. It appears that in 1879 President Henry Villard conceived the idea of lighting each room on board the new steamer "Columbia" by the electric light. The project was certainly a plucky one, but Mr. Villard never wanted for courage. By his orders, and under suggestions from Mr. Edison himself, Mr. J. C. Henderson, then advising engineer of the Oregon Company, wired the new ship with No. 11 wire for mains and No. 32 wire for branches, the wire being "underwriter's" insulated by double cotton paraffine, painted over all. There were four dynamos, one of which was run as an exciter for the others. All these machines were driven from a countershaft directly overhead, the countershaft belting to a pair of vertical engines at a very high angle to economize freight space. Our illustration gives a good idea of this arrangement.

In 1882 Mr. Henderson made an interesting report on the plant, from which we quote the following as to the lamps: "The first lamps used, being of the paper carbon variety, were irregular in their duration of life and so liable to breakage by heavy shocks that I found it best to suspend them from the wires above, and to do away with sockets entirely. The lamps being surrounded with a ground globe, the attachment was hid, the lights being suspended from the ceiling. Since the arrival of the ship on the Pacific coast we have received a full supply of new bamboo carbon lamps."

It may be mentioned that the paper carbon lamps first installed were delivered on board personally by Mr. Francis R. Upton, who brought them directly from the factory, with jealous care, and saw to their installation and the running of the wires, plant, etc, in New York, before the steamer started. Some of the experiences on the "Columbia" led to the introduction of safety fuses. Mr. Hiram Maxim saw some of these lamps on the "Columbia" in New York, and started out on his own incandescent work. The connection thus casually formed with the electric light industry by Mr. Henderson, led in time to the concentration of his energies on it, making him ultimately engineer-in-chief of the Edison General Electric Company. Thus, it will be seen, quite a chapter of electrical history gathers around the "Columbia" Edison plant, officially described in one of the old Edison bulletins as being "the first ever put in operation in the hands of strangers." The only ship lighting plant that could compete with this as a pioneer in the art was that built for the unfortunate exploring steamer *Jeannette*, and now lying in the cold depths of the Arctic Ocean.

Since the plant was thus put in for the "Columbia," hundreds and thousands of other steamers have been equipped with the incandescent light, but the advantages of the system have never since been more clearly pointed out than they were by Mr. Henderson himself in his official report exactly 10 years ago. The first point he made was that of economy, because "the light does not require the services of an attendant for trimming, lighting, etc., and there is less breakage." His next point was freedom from danger, "no matches being required." The extent to which the incandescent light has been a factor of safety on shipboard is in reality remarkable. As to ventilation Mr. Henderson remarked that "it is not necessary to keep doors and windows shut on account of smoking lamps or to prevent their being blown out." He dwelt also on "cleanliness and absence of disagreeable odor," and remarked that "the advantage of a non-smelling light at night in sick rooms is manifest." All this is true, but the incandescent light has so thoroughly gained the day that the argument has no longer to be made on these lines. In fact, there is no need to make an argument at all, for a first-class steamer not equipped with electricity is something one cannot imagine, and an absolute contradiction in terms.



DYNAMO PLANT ON BOARD THE S. S. "COLUMBIA," 1880.

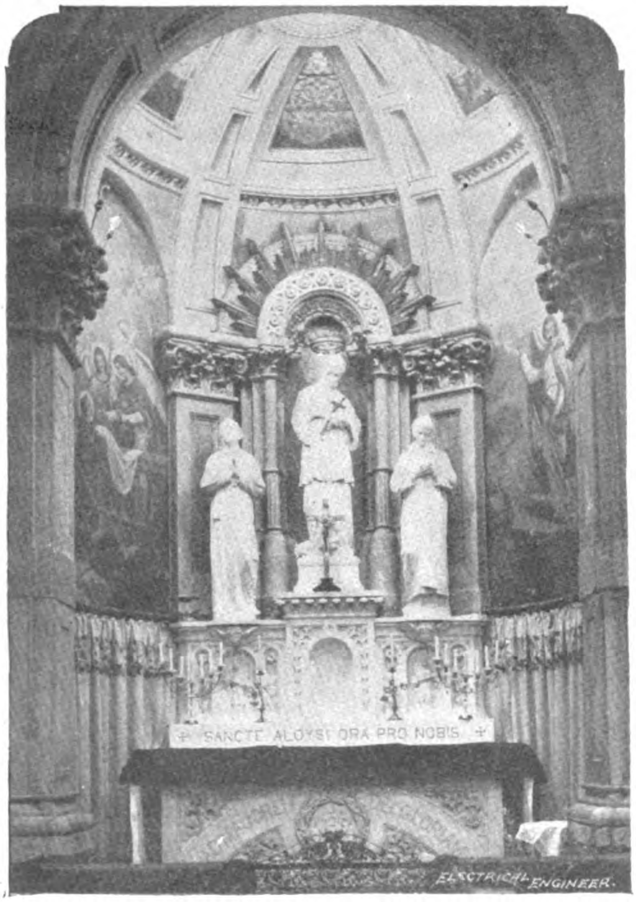
ELECTRIC LIGHTING IN CHURCHES: ST. FRANCIS XAVIER'S, NEW YORK.

BY

John McGhie

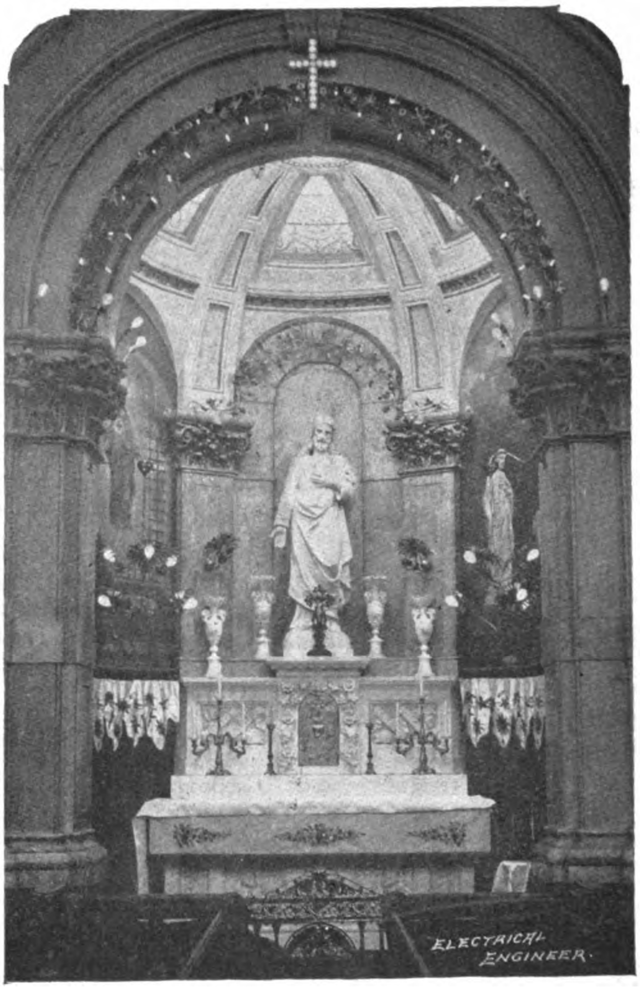
The electric installation in the church of St. Francis Xavier on West Sixteenth street, New York City, just completed, is an excellent example of the adaptability of the great illuminant to the enhancement of ecclesiastical architectural effects. Undertaken with many misgivings on the part of the Jesuit Fathers in charge as to whether it would infringe the rubrics, the task of electrically lighting the church from the pavement to the point of the arched roof has been accomplished with complete success, and St. Francis Xavier's, when fully lighted, has already become one of the unique and notable sights of the metropolis.

This church resembles nearly all other churches in its cruciform character, having the main altar at the apex of the cross, and chapels at each of the extremities of the transept. It is built in the Florentine renaissance style, and the florid, intricate stonework decoration lends itself admirably to the additional decorative effect of the electric light.



St. Aloysius' Chapel, Church of St. Francis Xavier.

On entering by the principal door beneath the great organ, the eye is confronted by a blaze of light from the high altar, and the alcove in which it is set. Three semicircles of numerous incandescent lamps spring from the capitals of the three rows of pillars superposed one upon the other. The uppermost semicircle is continued around the entire church, above the capitals of the first tier of columns above the gallery. Around the capitals of the first tier of columns springing from the pavement, the brilliant lights are also run, illuminating all the obscure corners of the structure, and effecting a wonderful change in the picturesque aspect of the interior of the building. The fixtures used to support the lamps and bring about this beautiful effect consist of small lengths of curved and polished tube, springing in graceful lines from the upper surface of the abacus of the columns, their juncture with the stonework being concealed by a border of polished metal. So closely together are the lights set that the double lines of light around the church seem continuous.



Electric Illumination of Chapel, Church of St. Francis Xavier.

The marble work immediately surrounding the tabernacle on the high altar has been worked in from behind, and in the recesses thus made incandescent lamps are set. These are lighted in the presence of the Host. A similar effect is obtained by concealed lights in the tourette. On each side of the high altar steps are two alabaster vases, from each of which spring six lilies. In each vase are two incandescent lamps. The stems of the lilies are of polished metal, the flower itself is a specially designed shade of opalescent glass, and the stamen is a frosted tubular lamp. When the current is thrown on to these pieces the effect is indescribably beautiful.

Above the pulpit on the outer edge of the sounding board is a silver dove in descending flight, laid against the background of a golden star. Concealed behind the star is a 50 c. p. lamp which floods the preacher and pulpit with a bright light as soon as the circuit is closed.

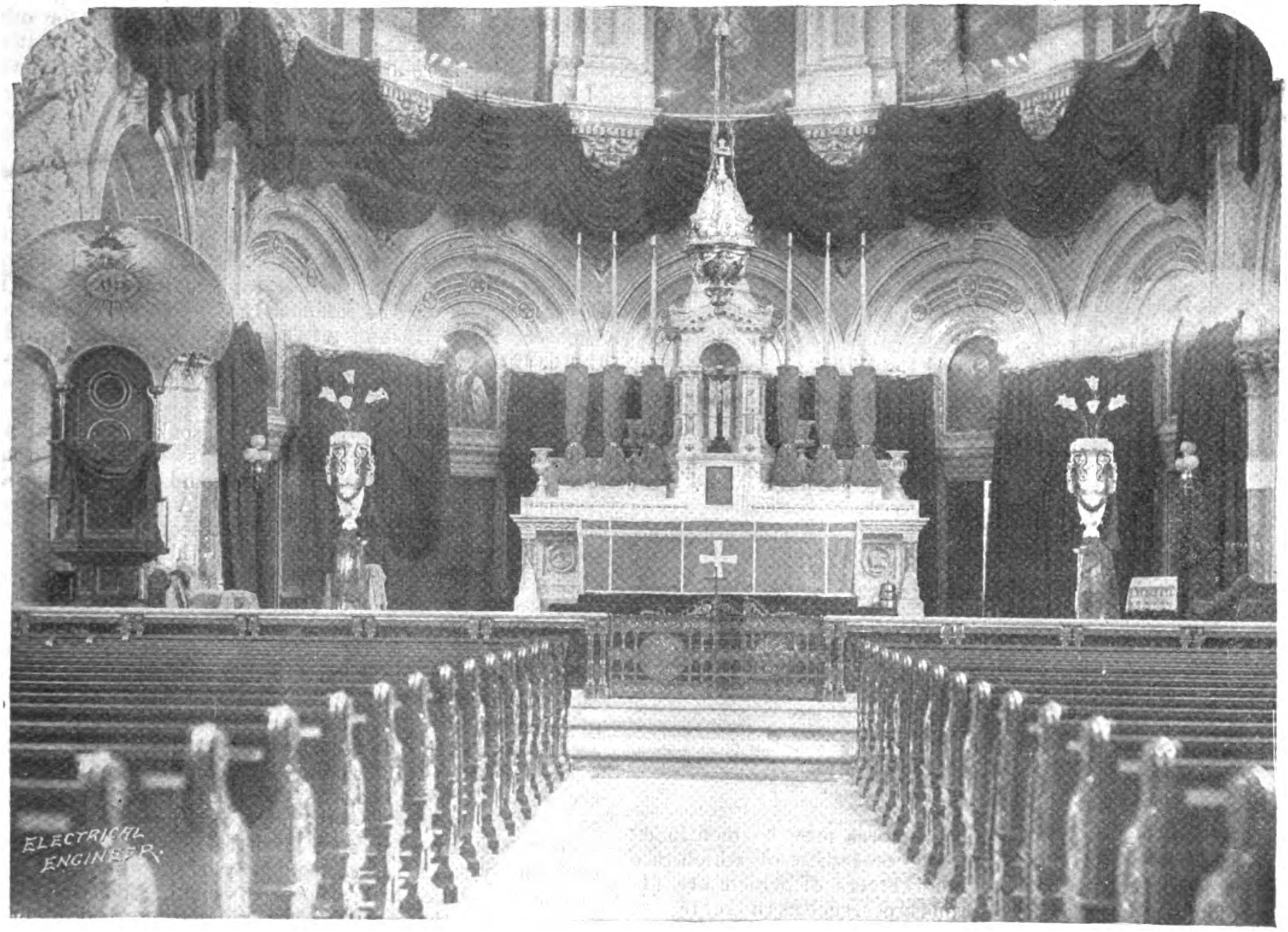
It is in the lateral chapels that the Saints-Pères have allowed their artistic proclivities to make themselves most manifest. In the Virgin's chapel to the left of the grand altar, the pendant crimson light has been removed from the centre where it obstructed the vision of the effigy of the Virgin and Child, and is now suspended from a handsome silver bracket at the side. Around the upper part of this chapel, and concealed from view, is a row of lights which shed a soft radiance over the Mother and Infant and the many floral offerings that are continually laid upon the small altar steps.

The chapel at the left extremity of the transept is, however, the most æsthetic of all. The same effect of concealed source of light behind the coping of the arch, is also employed here, but there are additions which render this chapel unique. Immediately above the head of the marble Christ runs a metal structure in the form of a grape vine, grapes and leaves being reproduced in the metal with faithful exactitude of color and form; in the centre is a bunch of wheat ears. This symbolizes the doctrine of transubstantiation in the Eucharist. Hanging from each side of the chapel are brackets of palm-leaves made of red hammered copper. These are the palms of martyrdom. Running over the outside of the arch is a passion-flower vine, each flower and each leaf perfect in its reproduction in hammered metal, the whole surmounted by a cross of incandescent lights—the cross of Constantine.

Immediately opposite this chapel is that of St. Aloysius, the principal feature of which is the crown of gilded metal studded with miniature lamps held over the Saint's head by two cherubs.

The crypt underneath the church has also been fitted with electric lights, as was the College theatre, recently destroyed by fire. In all there are about 2,000 lights in the church itself, while those in the other portions of the structure bring up the total to about 500 more. The photograph of the high altar was taken on the occasion of the funeral of Patrick Gilmore.

The current is derived from the street mains of the Edison Electric Illuminating Company, the wire being led to a slate switchboard in the sacristy at the rear of the high altar. The lamps are all divided into small groups each of which is controlled by its switch on this board. By this means the principle of economy in the consumption of current is not lost sight of.



ELECTRIC LIGHTING OF HIGH ALTAR, CHURCH OF ST. FRANCIS XAVIER, NEW YORK.

The decorative fixtures are all the work of the General Fixture Company, successors to the Fixture and Decorative Bronze Department of the Edison General Electric Company. They were made under the personal supervision of Mr. J. T. Robb. The wiring and all the work connected with the installation was in charge of Mr. D. Colombani, with whom the idea of thus lighting the church first originated and to whose energy the success achieved should be attributed. In effecting this installation many and serious difficulties were met with, but all have been surmounted and it is as an example of a perfectly lighted church that St. Francis Xavier's can be cited.

Virgin's Chapel, Church of St. Francis Xavier.

INSULATED ELECTRIC CONDUCTORS.—XIX.

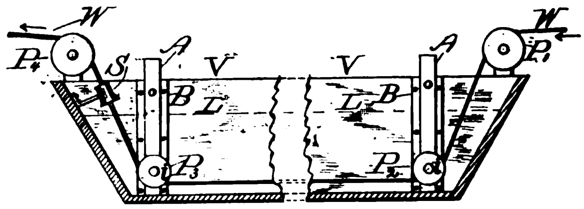
BY

James Bewstead Williams M.E.

As varieties of weatherproof wires may be mentioned those having dielectrics, the outer layers of which are saturated braids, and the inner layers of which are (1) previously prepared non-fibrous tapes, such as rubber tapes; (2) indestructible fibre, such as asbestos, with the interstices filled with *any* insulating material; and (3) a wrapping of prepared yarn, such as cotton saturated with paraffine. As further varieties of this general class of wires we may have those with coverings formed (1) of braids saturated with *solid* material which can be liquified by heat, such as ozokerite, bituminous matter, etc.; (2) unspun fibre, applied by wrapping and saturated with insulating material, *e. g.*, cotton applied while in the form of sliver and saturated with tars, pitches, etc. If this fibre is fine and is wrapped while wet it makes, when dry and saturated, an exceedingly tough covering. Its insulation resistance, like that of *all* prepared fibrous coverings, will, of course, depend upon the absence of moisture in the fibre, the kind of materials used, and the care taken during manufacture. And (3) fibre bound together with vulcanized compositions. In fact, the coverings of weatherproof wires may, and often do, consist of *any* combinations which do not readily change by exposure to the atmosphere. But if the coverings do not possess *insulating* properties, of what use are they? Simply protecting a copper wire from the air does not make it less dangerous when conveying high tension currents. The same question might be asked with reference to a fireproof covering that does not insulate well. If we make the bulk of a covering of asbestos fibre, *e. g.*, to be of any *practical* value the covering must be a complete one, and must *insulate* the wire. In order to do this the space between the fibres must be filled with a good and suitable insulating material and the fibre imbedded in the same. What kind of material shall we use for this purpose? The writer has never succeeded in finding a highly insulating material that was both fireproof and of practical value. If we fill the spaces with any *good* insulating material it will burn or be ruined by overheating, if an opportunity occurs, and what is the result? The material is either ruined at once or soon becomes so, in consequence of the overheating it has received. True, the *body* of the covering, if it be formed of asbestos, spun glass, or other non-inflammable materials, may remain unchanged, but the spaces which *were* filled do not fulfill their function,—that of making the covering a perfect envelope—the first fog or rain charges or fills them with moisture and the wire becomes dangerous. What we need are fuses, and promptly acting ones at that, rather than fireproof coverings if we wish to escape any damage which would be caused by an excessive current being suddenly thrown into circuit. *Any* insulated wire, if it becomes overheated from any cause whatever, will also overheat its covering; the insulation resistance of the covering will rapidly diminish and if the current on the wire be sufficiently strong an arc will form between this wire and any conducting body connected to earth with which the covering of the wire comes in contact. The consequences of such an event are only too well known.

A simple and convenient way of soaking the braids on several wires at one operation is to pass the wires through the same vessel containing the paint and thence to the different braiders for the outer braids. A reference to drawing, which is a vertical longitudinal section of such a vessel and its accessories, will show how this is done. $P_1 -- P_4$ are loose, deeply-grooved, pulleys; S is any suitable stripping device for removing the superfluous paint from the fibre before the wire W leaves the oblong vat V; L indicates the level of the liquid; A is a beveled strip in which the ends of the rod *i*, on which the pulleys turn, is fixed, and which can be secured to the sides of the vat by a bolt or otherwise; and B is a grooved strip fastened to the vat, and in which A can be moved up or down whenever it is necessary to remove the pulleys from the liquid, etc. If six wires are to be soaked it is evident that there must be at least six pulleys $P_1 -- P_4$ and six strippers. The pulleys on each rod are separated from each other by washers so each pulley can turn independently of the others.

The apparatus and process of soaking can readily be understood without any further explanation. Soaking braids in vessels separate from the braiders, although it may take a little more time, is to be preferred for these reasons: 1. The fiber remains longer in the solutions. If we allow an average speed of 50 feet per hour for a braider—in practice it is usually less—we can easily calculate the length of time the fibre can remain in a vat of a given length. 2. The fibre can be absolutely dry just as it enters the



Trough for Soaking Braids.

liquid. 3. But one vessel requires attention for a number of wires. 4. The soaked braid can be passed through a drying chamber between the vat and braider. By using certain kinds of paint, the soaked fibrous layer or layers can be dried, or nearly so, before the outer braid is applied. 5. There need be no leakage or spilling of the solutions. The stuffing boxes in the vessels attached to braiders are always liable to permit leakage and consequently a spattering on the machines or floor. 6. The fuzz on the fibrous layers can be more effectually removed. There are other reasons, but those given must suffice.

If it is desired to allow the fibre to remain a considerable length of time in the liquid reels containing the braided wires can be immersed in tanks or vats and the wires drawn off the reels, which revolve on rods like the pulleys, to the braiders or other apparatus for the final treatment. If the vat V, were provided with a steam-jacket or other means for heating its contents, *any* suitable material which could readily be liquified by heat could be used for saturating the fibre on wires in the same manner as the paint.

INFLUENCE OF FREQUENCY ON THE WORKING OF ALTERNATE CURRENT TRANSFORMERS.—II.

BY

Chas. Steinmetz.

From the plotted curves of magnetizing current and iron loss values were taken in equal intervals, and collected in the accompanying table, for comparison, giving for the three different frequencies the $E =$ E. M. F. in volts effective, $C =$ magnetizing current, in amperes effective, $W =$ losses in iron, in watts.

Since the magnetization, or magnetic induction B, is proportional to $\frac{E}{N}$ because $E = \sqrt{2}\,\pi\, n\, N\, s\, B\, 10^{-8}$, where s is the iron cross-section, N the frequency, n the number of turns, therefore in the table the values are arranged so that values corresponding to the same $\frac{E}{N}$, that is, the same magnetization, stand in the same line, and the value $\frac{E}{N}$ is given in the first column of this table.

TABLE OF ALTERNATING CURRENT TRANSFORMER TESTS AT DIFFERENT FREQUENCIES.

	$N = 204.5$ periods.				$N = 137.5$ periods.				$N = 36.3$ periods.				Average.		Calculated.
$\frac{E}{N}$.	E.	C.	W.	$\frac{W}{N}$.	E.	C.	W.	$\frac{W}{N}$.	E.	C.	W.	$\frac{W}{N}$.	C.	$\frac{W}{N}$.	$\frac{W}{N}$.
.2	40.9	.74	13.4	.066	27.5	.76	10.1	.074					.75	.070	.068
.3	61.4	.88	26.8	.131	51.3	.89	18.9	.137					.885	.134	.131
.4	81.8	1.02	42.5	.208	55.0	1.01	28.9	.210	14.52	.95	7.2	.198	1 015	.209	.207
.5	102.3	1.11	60.1	.294	68.8	1.15	40.4	.294	18.15	1.10	10.3	.284	1.13	.291	.296
.6	122.7	1.29	79.3	.388	82.5	1.28	53.5	.389	21.78	1.24	14.0	.386	1.27	.388	.397
.8					110.0	1.57	83.5	.608	29.04	1.58	22.0	.607	1.575	.608	.628
1.0					137.5	2.08	120.0	.874	36.30	2.08	32.0	.883	2.08	.879	.896
1.2									43.56	3.65	44.0	1.21	3.65	1.21	1.20
1.4									50.82	10.8	60	1.65	10.8	1.65	1.54
1.5									54.45	25	68	1.87	25	1.87	1.72

As seen from this table, to the same $\frac{E}{N}$ corresponds in the different frequencies, the same magnetizing current. This means that:

For the range of frequencies from 36.3 *to* 204.5 *complete periods per second the magnetic characteristic is constant, and independent of the frequency.*

Or in other words, within this range,

Up to 204.5 *complete periods per second, magnetic viscosity does not yet exist,*

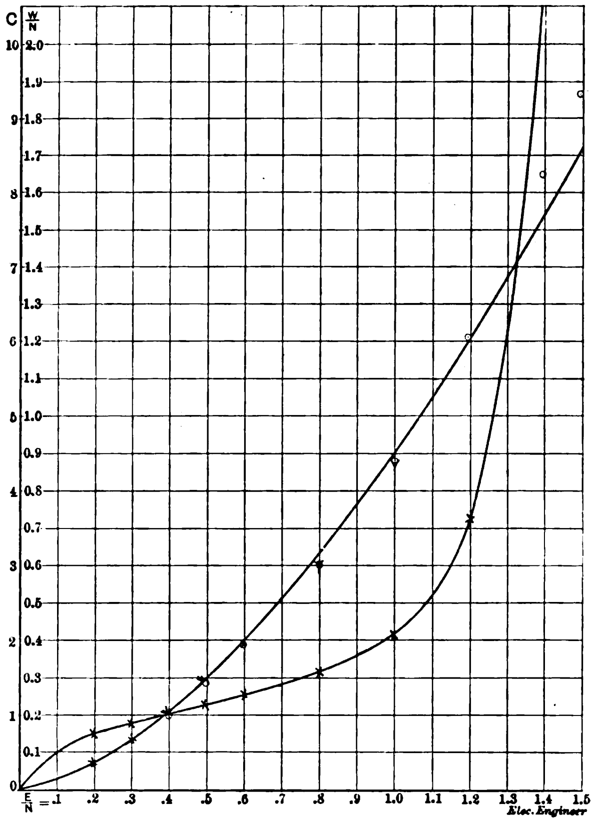


FIG. 2.

but the magnetism follows the M. M. F. as completely as for slow cycles. Eddy-currents, consequently, had no influence on the magnetic characteristic within this range.

To compare the iron losses, in the fourth columns the values $\frac{W}{N} =$ iron loss per cycle, are given. As will be seen, the iron loss per cycle is the same for slow as for high frequency, this means that:

The hysteretic loss per cycle is independent of the frequency, and eddy-currents are practically absent.

Hence, this table proves that:

If eddy or Foucault currents are properly excluded, the magnetization, and the hysteretic loss of a transformer *can, up to* 200 *complete periods per second, be predetermined exactly by calculations based on tests with slow cycles, magnetic viscosity and viscous hysteresis being absent.*

In the last three columns the average values of current, C, and of iron loss per cycle, $\frac{W}{N}$, are given, and the values of $\frac{W}{N}$, calculated by means of the law of 1.6th power, which agree very closely, as seen, with the observed values, except in the last two readings, where, as explained before, the exactness of the method is not sufficient to expect closer agreement.

The values of this table are plotted in Fig. 2, with the magnetization, $\frac{E}{N}$, as abscissæ, and the magnetizing current as ordinates, giving thereby the magnetic characteristic of the transformer iron, in a modified form. The second curve of Fig. 2 is the iron loss per cycle, $\frac{W}{N}$, as a function of the magnetization, $\frac{E}{N}$. By means of these observed curves, we are enabled now to determine the behavior of this transformer under any conditions of load and frequency.

A WEATHER TEST OF TRANSFORMERS.

The present extremely severe winter has subjected all outdoor electrical work to a very searching test, and the illustration shown herewith is one striking example of the ordeals that apparatus deserving of better treatment has to endure. Our vignette, made directly from a photograph taken on the spot, exemplifies pretty clearly what will happen sometimes when we are compelled to hang our transformers where Macbeth hung his banners—"on the outer walls." To sustain such an extra burden of ice and snow a converter and its wires need be very securely fastened, and even then if something gave way it would scarcely be the transformer's fault. As to the improvement in safety and insulation likely to result from such an exposure, perhaps the less said the better. There is some consolation in the fact that the dry ice has saving virtues, but as ice has an unfortunate tendency to get wet and stay so as long as its bank account holds out, it is evident that the conditions, as a general thing, become very unfavorable. The transformer shown in the cut is of Westinghouse make, and that it stands such abuse speaks volumes in its favor. Yet, after all, it does seem unreasonable to place apparatus under such a stress when it would be in every way safer in a dry cellar.

A WIRE GAUGE CHART FOR DETERMINING THE AMPERE TURNS ON SHUNT MAGNETS.

BY

Wm. R. C. Corson.

The accompanying chart as its title implies, is designed for the the purpose of determining the ampere turns obtainable from the different sizes of wire under given conditions of length, of turn and drop in voltage between the terminals of a magnet coil. It has proved of much advantage to the writer in the designing of dynamo fields, as from it the engineer may see at a glance the size and amount of wire necessary for a given machine and thus have a basis for laying out the dimensions involved. The chart also serves as an approximate check for more accurate calculations. Brown and Sharpe's wire gauge numbers have been used, but, as the scale is laid out on a system of which the circular mil is the unit, any other gauge numbers may readily be supplied.

From the chart may be determined :—

1. The ampere turns of a given size of wire at a given average, length of turn and a given voltage and conversely.
2. The size of wire that must be used in order to obtain a desired M. M. F. of a given number of ampere turns, at a given length of turn and given voltage.
3. The weight of wire that must be used in order that no more than a safe current shall flow through the coil.

To obtain the first result, find the number of the wire to be used on one of the horizontal lines to the right, noting whether it be the 1st, 2d, 3d, or 4th line. From this wire number, follow vertically upward to the heavy diagonal line marked "ampere turn line," thence across to the left to the diagonal corresponding to the length of a turn, then down to the lower left hand quadrant to the diagonal of proper voltage, and again to the right to the vertical ampere turn scale. The reading on this scale must be multiplied by 10, 100, 1,000 or 10,000 according as the wire numbered is in the 1st 2d, 3d or 4th line.

The following examples will show clearly the method of using the chart.

1. To find the ampere turns obtained by using No. 21 wire on a 220 volt field at an average length of turn of three feet.

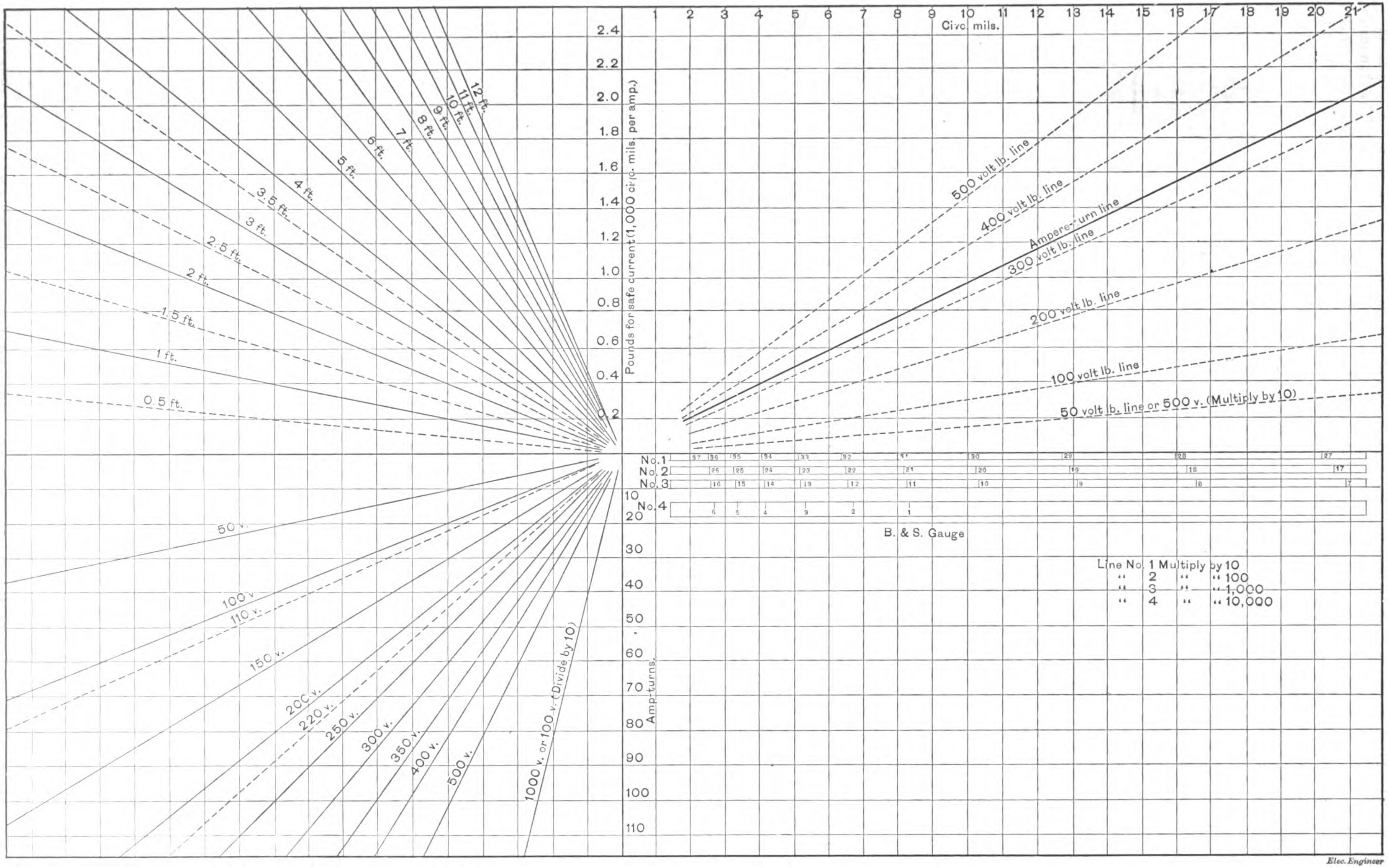
We find No. 21 wire on the line No. 2 and follow up the vertical line to the heavy "ampere-turn line ;" then across to the left to the 3-foot line ; down to the 220 volt diagonal ; and to the right again to a point on the "ampere-turns" scale which in this case reads 58. But we found No. 21 wire on the line marked No. 2 ; therefore we multiply 58 by 100 and obtain as our result 5,800 ampere-turns.

2. The converse of this problem is accomplished by a mere retracing of our steps. Starting from the given number on the vertical "ampere-turns" scale, and remembering the power of ten by which we multiply the scale reading to give this number, we trace to the left proper volt line ; then up to the diagonal corresponding to length of turn ; across to the heavy "ampere-turn line," and down to the B. & S. numbers. Here we find the proper line from the power of ten used in multiplaying at the start.

Example: To find the size of wire neccessary to obtain 40,000 ampere-turns at a pressure of 500 volts, and at an average length of turn of 5 feet.

Starting from point 40, to 500 volts, to the 5-foot line, to the ampere-turn diagonal brings us down to a point which might read 34, 24, 14, or 4. But we multiplied by 1,000 at the start, in order that the scale reading be 40,000 instead of 40. This shows us that the number of wire desired is in the line No. 3 and is therefore No. 14.

3. To find the weight of wire necessary to have 1,000



Wire Gauge Chart for Determining the Ampere Turns on Shunt Magnets.

circular mils per ampere of current, start from the number of the wire and follow up to dotted diagonal reading the proper voltage; then to the left to the vertical scale marked, "Pounds for Safe Current." This scale reading, like the others, must be multiplied by a power of ten corresponding with the line in which the wire number was found.

Thus, to find the weight of wire neccessary in the last example taken, from No. 14 follow up to the dotted diagonal marked 500 volts; then across to scale, reading 0.59. This multipled by 1,000 gives 590 lbs. as the weight necessary. Other sections of conductor per ampere may be determined by direct proportion.

The weights given are for bare copper wire, and resistances for pure copper at 75 degrees Fahrenheit.

THE SCOTT-SISLING SYSTEM FOR ACCUMULATOR INSTALLATIONS.

BY

W. B. Sisling.

Nearly eighteen months ago this arrangement was described in The Electrical Engineer with the aid of a rough diagram. Since then its use has considerably extended and its details have been perfected. Fig. 3 shows the switchboard, which enables a compound dynamo to be run in parallel with accumulators without risk of reversal.

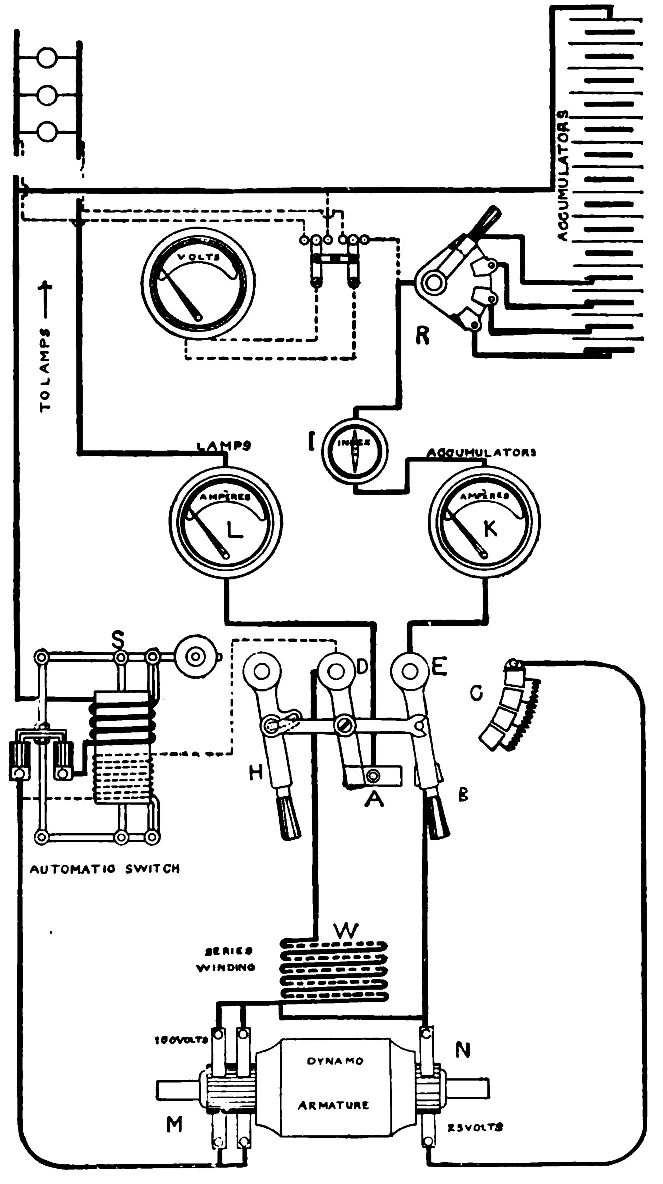


Fig. 1.—Diagram of Connections.

A is connected to lamp main through the ammeter L. B is a contact for running cells in parallel with dynamo. C is the contact for charging cells. It is divided into sections connected by resistances. D is the dynamo switch. H is the handle for closing dynamo switch. E is the accumulator switch connected to cells through the current index I, and the ammeter K. R is the regulating switch for adjusting the number of cells in circuit. W represents the series winding of dynamo.

The dynamo is a special one, and is shown in Fig. 2. It has an extra commutator arranged to give the additional E. M. F. required for charging accumulators. The dynamo can, therefore, be driven at constant speed (as from mill shafting or from an engine with a good governor) and will supply steady voltage to the lamps, although it is at the same time charging accumulators and subject to fluctuations in the number of lamps alight. The charging of the accumulators can be regulated in such a way as to partially balance these fluctuations, thus keeping the load approximately steady and securing economical conditions of running. The arrangement thus shortens the working hours of the plant by avoiding the necessity for running specially to charge the accumulators during the daytime.

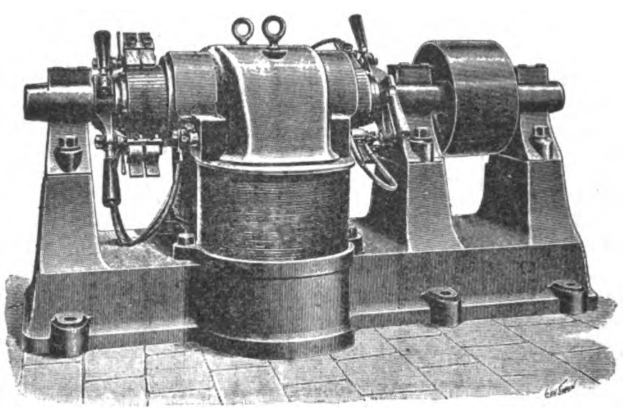


Fig. 2.—Special Dynamo for Charging Accumulators.

The battery assists the dynamo when necessary at full load, and is always in readiness to do this without alteration of switches when it is not being charged. Only one battery switch is required, as it is always in circuit, and thus answers for both charging and discharging.

The whole arrangement of connections is clearly shown in Fig. 1, from which the working may be traced.

The plant is made by Messrs. Laurence, Scott & Co., Ltd., of Norwich, England, and seems to hit the mark for those installations which have to be operated by comparatively unskilled men, as its manipulation is very straightforward.

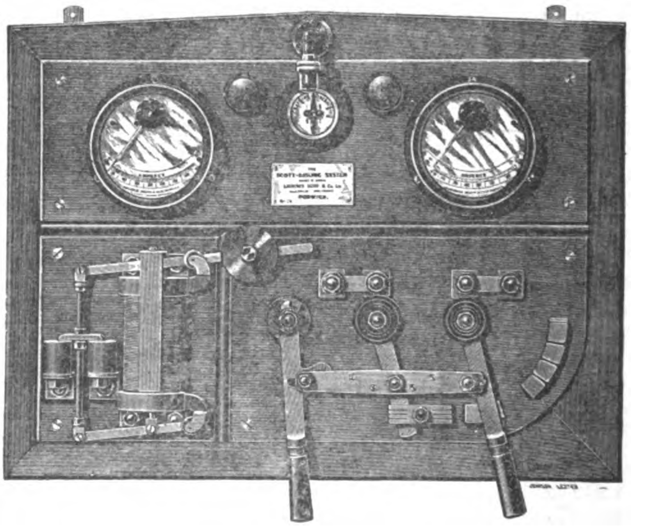


Fig. 3.—Switchboard for Charging Accumulators.

"TAKING THE DOUGHNUT."

A New York electrical engineer and expert writes: "I take pleasure in renewing my subscription to The Electrical Engineer for which I enclose $3. It strikes me that The Electrical Engineer is taking the doughnut away from them all."

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GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
Western Editor and Manager, L. W. COLLINS, 575 The Rookery, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 501 Girard Building, }

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CONVENTION TOPICS.

THE meeting of the National Electric Light Association at St. Louis, this week, is an event of unusual importance, and will without doubt be well attended. It is some time since the Association went so far South and West, and in the interval not only has the electric light and power industry developed greatly, but the growth in the region supplied from St. Louis has been very rapid and extensive. The electrical facilities of the city are second to none in the Union, and this fact alone would make the visit a pleasant and profitable one to active, inquiring men, anxious to discover the best practice in the art up to date. But St. Louis is a city of generous and hospitable proclivities, and has determined that on this occasion as on every other, her guests and those of President Ayer, shall find themselves thoroughly at home.

In addition to the attractions of the convention city, are those of the programme furnished by Secretary Porter, who has made a most judicious selection of authors and topics and who has rallied to his support some of the brightest men in the profession. Further éclat is given by the appearance of Mr. Nikola Tesla, who too rarely honors the platform and whose remarkable researches have not been publicly illustrated in this country for nearly two years.

In Mr. Tesla's work is the rich promise of many things yet to be, and when we consider how quickly his ideas and inventions in the field of alternating current motors have fructified, we may fairly be sanguine as to the other problems in light and heat that he has set out to solve. It is such leaders as he that guide ever into Canaans flowing with the milk and honey of new opportunities, and electricity has not yet wanted for such men.

Meantime, the members of the convention will doubtless discuss in private, if not in public, the situation that has been constituted so curiously and anomalously the last year by the consolidation of old antagonistic parent companies and the validation of fundamental patents under their control. The electric lighting industry is still an open one, yet it would be worse than foolish to say that it is not better to be within the protection of such patents than outside it. The very object of patents is to create new property and to encourage investment by the stability and shelter afforded. Shall it be that men like Edison, Elihu Thomson, Brush, and scores of others have worked in vain, and that money has been wasted in perfecting and introducing their inventions? If so, the inventive genius of the age will forsake electricity very quickly for other fields of labor.

That is one view of the situation—a sound and fair one—but not complete. To-day, a single lamp patent affects the largest department of electrical activity in lighting and current distribution. That patent is a mainstay of interests that but yesterday were fighting it, and stands in the name of an inventor who opposed with all the weight and force of his tremendous personality the use of the alternating current and apparatus by which a greater extension has been given to the incandescent art than it ever enjoyed before. Outside of that patent, and outside those interests, money, time and genius have been spent like water in building up the art, in devising improvements, in refining apparatus, in cheapening and simplifying details. It is therefore the sense of the electrical industry and profession, as it should be and perhaps is, the dictate of the law, that one patent shall not enjoy all the reward due to hundreds of others, and that one interest shall not preëmpt for itself all the profit that the art as a whole is entitled to as its return for the benefit conferred on society. The man who invents type, it is argued, should not usurp the gains of the man who perfects paper, nor shall these together crowd out the men who have perfected the printing press, the book binding machine and the best printer's ink. But there is a deep-seated fear in many quarters that just such a selfish policy is to be attempted in the electric lighting and power field.

For ourselves, we refuse to believe that such a policy will be tried, or if tried, will prevail. Our firm conviction is that the best interests of the controling companies, the best interests of the local companies and the best interests of the consuming, purchasing public, the ultimate bearer of the tax, demand a broad, liberal, comprehensive policy, which sees its triumph not in a restriction of the field to a few, but in a stimulation of every thought, agency and activity that can help to extend the art. For the adoption and maintenance of this policy we shall contend, believing as we do that it will carry with it general prosperity and the success of all the principles that the National Electric Light Association has striven for.

The Westinghouse Lamp.

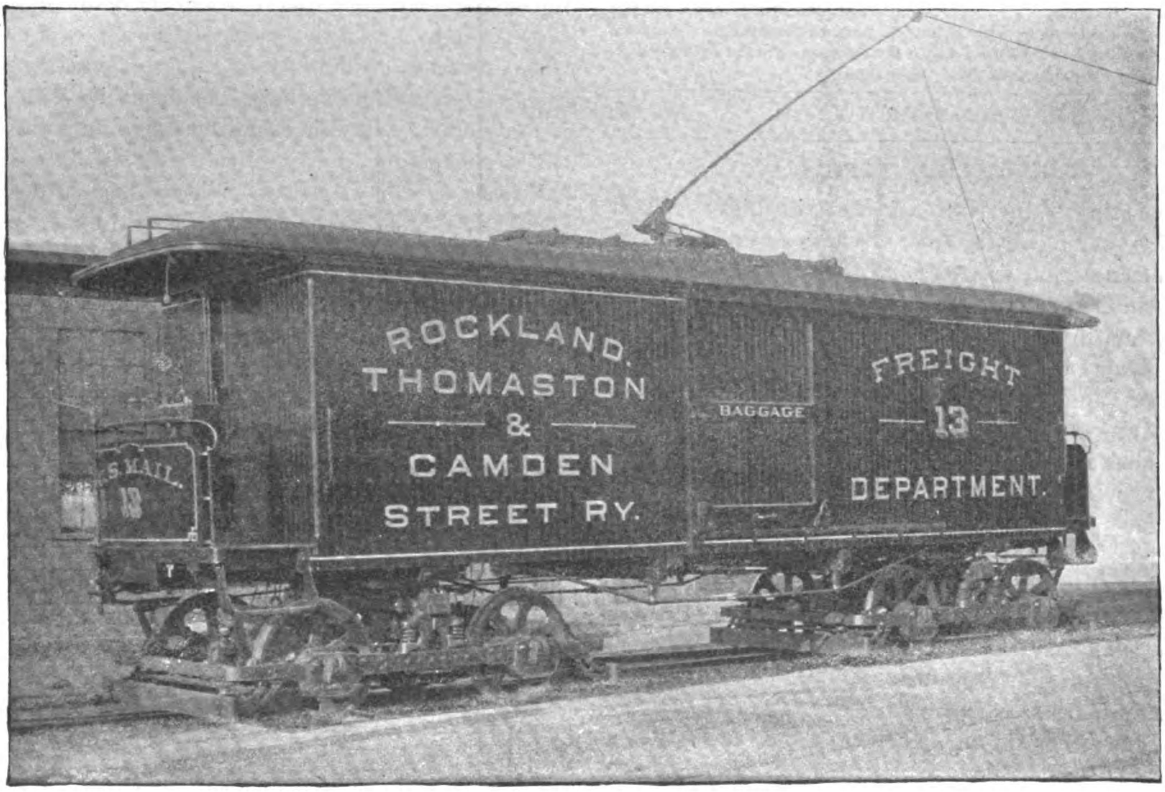
The opinion of the United States Circuit Court at Pittsburgh—of which the main portion is printed in our Legal Notes—in the matter of the new Westinghouse lamps, may be regarded as in some degree a victory for the Westinghouse Company; for while it grants the motion of the Edison Company to dismiss the rule to show cause why the standing injunction should not be modified or construed so as to free the new lamp, yet the Court commends the spirit in which the Westinghouse Company approached it, and leaves them free to go on with the new lamp until a final hearing in the pending suit.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC FREIGHTING AT THOMASTON, ME.

The benefits conferred upon neighboring towns by an electrical interurban passenger railway have become so universally acknowledged, that the adaptation of the street railway motor to freight service seems only a natural consequence. There are, however, but few examples of this, and it is a pleasure to us to describe such an adaptation in the hope that the good example may be followed.

Through the towns of Rockport and Camden, Me., runs the Rockland, Thomaston and Camden Street Railway, at present 9½ miles in length, with a probable extention of three miles to the town of Thomaston. The Knox and Lincoln Road, an extention of the Maine Central Railroad runs as far as Rockland only. At that point the country assumes markedly hilly characteristics and offers considerable difficulty to the extension of the steam road to the seaport towns of Rockport and Camden. An electric road was therefore laid down, with extremely successful results; fulfilling in every particular the best provisions of the steam roads.



Electric Freight and Motor Car, Rockland, Thomaston & Camden (Me.) Street Railway.

So successful, indeed, has been the passenger service, that the project of establishing a freight service seemed to the Street Railway Company excellent, and the experiment was decided upon. An order was placed with the General Electric Company for one locomotive freight car, which we illustrate. The car resembles those in use on steam railroads. It is provided with sliding doors in the centre of each side and smaller ones at both ends to give access to the platforms. It is 25 feet long, 7 feet wide, and 7 feet high and has, at each end, a platform 30 inches wide, protected by the overhang of the car, and having a dashboard in front, similar to those in use on the street cars. The platform is fitted with brake, controller and reversing switch, foot and starting gongs and a single lamp. The interior is illuminated by three lamps in series with the platform lamps.

The body of the car is mounted on two No. 29 Bemis steel trucks with wheels to the standard gauge. On each axle is mounted a General Electric W. P. 50 motor, making four motors in all and current is taken by means of the ordinary overhead trolley. The car weighs a little over 15 tons and has a carrying capacity of 20,000 lbs. It is intended to use this car as a locomotive, pulling an ordinary freight car as a trailer, which will add about 9,000 lbs. to the weight to be propelled by the motors.

The car is guaranteed to carry at least 20,000 lbs. up an 8 per cent grade at a maximum speed of about 5 miles an hour, with a maximum on the level of about 10 or 12. Of course if this can be exceeded, our intimate knowledge of the motor-man in general, and of his aspirations, leads us to believe that it will. He is sure to "let her out." The car itself is a handsome structure painted dark red, with white lettering, and having nickeled and black trimmings.

The road itself is built in a most substantial and workmanlike manner, with 50 lb. T rails laid on sleepers two feet between centres, the idea of a freight service having been contemplated from the outset.

One of the most important facts in connection with this road is that it has secured the contract to carry the U. S. mails between the towns through, and to, which it runs. This service has been undertaken at a merely nominal figure, but the benefits the Company are likely to derive from the right of way and federal protection which connection with the post office gives them will amply repay them for any loss they may incur in the actual transport of the mails.

ANOTHER LARGE TROLLEY SCHEME FOR NEW JERSEY.

A CORPORATION with small capital and big capitalists behind it was incorporated by the Legislature at Albany, on February 16, "for the purpose of constructing railroads and furnishing power to railroads in New York City." The capital is $5,500, and among the directors are President John A. McCall of the New York Life Insurance Company, Henry B Hyde, Gen. Louis Fitzgerald, and Superintendent F. K. Hain of the elevated road. President McCall states that the company has nothing to do with the elevated road or with the present Metropolitan Traction Company. "It concerns one electric surface road in New Jersey and two horse railroads in this city," he added. "The electric road is in Paterson, N. J.. and consists of the Grand Street, Paterson, Central and Little Falls branches. This road was organized some time ago with a capital of $200,000, which was all paid in. It has no debts, and has been quite prosperous ever since it started. The two horse railroads in question noted the success of the Paterson electric street railway, and made overtures looking towards their purchase by it. The directors of the Paterson road desired to accept the offer of these two horse railroads, but found that their charter would not permit them to make the purchase. For this reason it was decided to organize the New York Traction Company, which should have the power both to buy both the Paterson road and the two horse railroads. The names of these latter roads I am not at liberty to mention, because the negotiations between them and the Traction Company are not yet completed. The smallness of the capital is on account of the tax laws. As we absorb the companies referred to we can increase our capital. It is our intention to ask the officials of Bergen County to grant us a franchise for laying a double-track trolley road from Paterson to the Hackensack River and across the Secaucus bridge into Hudson City and Hoboken, the authorities of which will then be asked to permit the extension of the road to the Hoboken ferry on the Hudson River. Something like fifty miles of track will be laid at an estimated cost of about $500,000. If we succeed in buying the two horse railroads, we shall equip them with the trolley. We do not intend to extend our purchases beyond the two roads in question."

The directors of the new company are: ex-State Senator Charles H. Russell and Charles Currie of Brooklyn, James A. Morrissy and F. C. VanDyke of Paterson, N. J.; Charles A. Johnson of Johnson, Kenny & Co., Raymond C. Johnson, Thomas D. Jordan, George V. Turner, W. H. McIntyre, Superintendent Hain and President McCall.

A WIDE-REACHING TROLLEY CONSOLIDATION IN NEW ENGLAND.

A NUMBER of street railways in Boston, New Haven, Providence, Springfield, and other cities in New England have been consolidated in one company under the name of the New England Street Railway Company. The certificate of incorporation, which was filed February 16 in the office of the Secretary of State of New Jersey, at Trenton, N. J., provides for a capital of $5,000,000, which may be increased to $50,000,000. The directors of the company, including many prominent New England financiers, are as follows: John R. Bullard, president of the Dedham (Mass) Savings Bank and the Dedham National Bank; James C. Elmo, president of the Shoe and Leather National Bank, of Boston; Col. John H. Cunningham, president of the Winnisimmet National Bank, of Chelsea, Mass.; W. B. Ferguson, president of the Gloucester Street Railway Company, Gloucester, Mass.; Hon. William H. Leonard, vice-president of the North National Bank of Boston; Dr. A. F. Mason, capitalist; Maj. A. C. Pond, president of the New Haven and West Haven Street Railway Company; A. R. Mitchell, vice-president of New England Trust Company, Boston; Thomas T. Robinson, treasurer of the West Leicester and Spencer Street Railway Company, Boston; James B. Dill, of Dill, Chandler & Seymour, New York, the counsel for the company. The charter obtained by the company is one of the broadest charters ever secured under the General Act in the State of New Jersey, and gives the company even more latitude than the now famous charter of the North American Company, which was organized in the same State under the same act. The Corporation Trust Company, of New Jersey, is designated as the trustee of the company in New Jersey, and the New England Trust Company in Boston as the trustee in Boston.

TROLLEY CARS HAVE RIGHT OF WAY.

THE supreme court of Pennsylvania, through Justice McCollum, in the case of Winter against the Federal Street and Pleasant Valley Passenger Railway Company of Pittsburgh, gave on January 31 an opinion which will probably greatly affect street railway matters in this state. The defendant corporation is an electric railway and is operated by means of the trolley system. The plaintiff was the owner of a truck and two horses. He was employed in putting a safe into a building and his horses stood in a position to impede the progress of the cars. Several times he moved his horses in order to let the electric cars pass, but finally refused to move, contending that he had a right to the thoroughfare for a length of time sufficient to finish his work. One of the cars came along and, running into his horses, inflicted such injuries that he was compelled to kill them. Suit was begun in the common pleas courts of Allegheny county and a verdict secured for damages just sufficient to cover his loss. The defendant company applied for a new trial but was overruled by the Judge. The supreme court reversed the decision or the court below. If the cause given had been contributory negligence there would be no cause for general complaint, but in his opinion, Justice McCollum, in order to strengthen the contributory negligence reason, said: "In these days of rapid transit, by means of the cable and trolley systems of car propulsion, property-holders along the line of the route and citizens generally must be given to understand that that there must be an abridgment of their uses of the street. To use them now as in the days of car horses would be impracticable."

The opinion is a long one and is devoted to emphasizing the rights of the cable and trolley rapid-transit companies to the right of thorougfares.

THE TROLLEY SYSTEM IN BROOKLYN.

THE shareholders of the Brooklyn City railroad have ratified the lease of that road to the Brooklyn Heights Company. Legal proceedings to prevent the lease from going into effect were also begun by James C. Church on behalf of Joseph B. Markey, a stockholder in the road.

This plan of leasing the road has been under consideration for several months, and president Lewis and a syndicate have been buying the stock of the Brooklyn City Road for nearly a year. Their purchases recently sent the market price up to $300 a share. The terms of the lease are that a dividend of 10 per cent. is to be guaranteed on the old Brooklyn City stock, but Mr. Markey alleges that, with the introduction of the trolley system the road can earn at least 18 or 20 per cent. and that the men on the inside are going to divert that excess of profit to the leasing company, which they own.

The Brooklyn Heights Company has hitherto been a small concern that operates the short cable road through Montague Street, to the Wall Street Ferry. It has a capital of only $200,000, and the stock had no market value until a few months ago, when president Lewis and his friends started in to get control and bid it up to $75, a share.

The capital of the Brooklyn City Road is $12,000,000, and it is upon this capital that the guaranteed dividend of ten per cent. is to be paid.

FINANCES OF THE LONDON UNDERGROUND ELECTRIC ROAD.

THE financial result of the working of the City and South London Railway for the half-year ended December 31st last, shows an improvement upon that arrived at in the corresponding period of 1891. During the last six months of 1892, the passenger receipts amounted in round figures to £22,000, as against £19,800 for the last six months of 1891. On the other hand, the corresponding total expenses were in round figures £15,390 and £15,516; the outcome being a dividend at the rate of ⅝ths per cent. per annum to the ordinary shareholders. Since the opening of the line some two years ago, more than 11⅛ million passengers have been carried; and the figure for the last half of 1892 exhibits a 17 per cent. increase upon that for the corresponding period, the increase in train mileage being nearly 14 per cent. The locomotive and generating expenses per train mile run are now down to 7.1d.

A COMBINATION PLANT FOR GRAHAM, VA.

MR. WALTER GRAHAM of Graham, Va., has secured the franchises for the towns of Graham, Va., and Bluefield, W. Va., for electric lighting and electric railway. It is the intention to connect these places, which are about two miles apart, by an electric street railway, and to light both towns with incandescent and arc lights, all to be done from one central power house. A company has been formed and capital is being invited to invest in the enterprise. The situation is but one of many in which combination plants should prove very profitable.

RADIAL CARS IN BOSTON.

THE WEST END STREET RAILWAY COMPANY of Boston is the defendant in a suit begun in the United States Circuit Court in that city, in which the damages claimed are $1,500,000. The plaintiff is the Robinson Radial Car Truck Company, and the suit is based on alleged infringement of letters patent owned by the plaintiff, covering the manufacture, use and sale of electric radial trucks.

WORLD'S FAIR DEPARTMENT.

DETAIL ELECTRICAL WORK ON FAIR GROUNDS AND BUILDINGS.

THE long spell of intensely cold weather that has been experienced universally throughout the country has delayed nearly every branch of work at the Exposition grounds, notwithstanding the strenuous efforts that have been made to keep the work moving. The ground is frozen to a depth of two feet and all excavating is done at great expense. The foundations for several new buildings have recently been laid, the frozen earth being blasted out with dynamite as if it were solid rock.

In laying ducts for electric wires a trench is dug about twenty inches wide and the same in depth. Most of this work was done last fall before the cold weather set in, but in some places it could not be reached in time and the ground froze. Now a man can dig about three linear feet of trench of this size (*i. e.* 20 inches wide and deep) in a day. In fact it has been necessary to stop all work on the outside of the buildings and in all exposed places. Even inside the men work at great disadvantage because of having to wrap themselves up so heavily to keep warm, and frozen hands, noses and ears are very common. In the annexes to the Gallery of Fine Arts the wiremen follow closely on the heels of the carpenters and wires are strung on roof timbers as soon as they are in place, the men working in the snow as it drifts into the yet unroofed buildings. Owing to these difficulties there is not much to record in the way of new developements in the electrical work.

MAIN ENTRANCE TO ELECTRICITY BUILDING.

After one of the heavy rainfalls that occurred early in the winter a force of men were sent out by the Landscape department to dig trenches to turn the water that had accumulated in the lower spots in the roads into the sewers. These men, laboring under the delusion that everything in the nature of a hole in the ground was a sewer, carefully unscrewed the covers from the electric manholes and turned the water into them. A long period of cold weather followed, and the ducts being only 18 inches below the surface, the water in them froze solid. When the work of drawing in the cables was begun a few days ago it was found that there was no hole to draw them into, a cake of ice having taken its place.

As it was not possible to delay the work of drawing in the wires until the weather was warm enough to thaw the ice, various schemes were suggested to overcome the difficulty, and a jet of steam was decided upon as being the most efficient and convenient.

The next question was how to get a supply of steam for the purpose in such parts of the grounds as were not near a boiler. At last a novel idea was hit upon. Among the goods and effects of the Exposition are several small steam rollers used for rolling paths. These weigh about two tons each. It was proposed that one of these be used to supply steam to thaw the ice from the ducts. The snow being deep and the road ways covered with ice, it was found that the roller would not "work its own passage," so it has been mounted upon a sled and four horses drag it from place to place as its services are required. The scheme is quite successful and the most refractory length of frozen duct yields in a few minutes. A length of rubber hose is run from the blow-off cock of the boiler into the duct and as soon as one length between two manholes is thawed out the manhole is bridged with a piece of pipe and another length thawed without moving the roller. So successful has this proved that a large 10-ton roller has been fitted with ice creepers in the shape of large spikes fastened on the wheels and the work is greatly hastened by its aid. The operation of drawing in cables is progressing rapidly and it will not be long before the temporary poles and wires disappear. The interior wiring for arc lights has been delayed somewhat because the aisles could not be laid out until the exhibit space was allotted. This has been finished in nearly all the buildings and the work of wiring is now going rapidly forward.

Several hundred of the arc lamp posts are now in place and more are continually arriving. Before they are set on the foundations the latter are carefully shimmed to correspond to the grade line of the road. All posts are inspected as they are unloaded from the cars, and the imperfect ones rejected.

The work of installing the electrical machinery in the great central station in Machinery Hall has begun. Two 4,000-light Westinghouse alternators have been placed upon their foundations within the past week and are now ready to run as soon as power is to be had. They are belted direct, each to a 400 h. p. Westinghouse compound engine. The engines are set up and only need steam connections to make them ready for duty. The temporary power plant is loaded beyond its normal capacity and as the demands for additional lights are constantly increasing, the work on the permanent plant is being pushed as rapidly as possible in order to relieve the overworked boilers of the temporary plant. Two of the 10,000-light machines have been shipped from Pittsburgh and will soon be in position on the foundations prepared for them. One of these machines is to be connected directly to a 1,000 h. p. Westinghouse compound engine. The other is to be driven by the 2,000 h. p. Allis Corliss engine by means of a belt six feet in width. The pulley for the dynamo shaft is nine feet in diameter and six feet in width of face. Nine Fort Wayne, nine Standard, and several Brush arc machines are being installed, though the engines which are to drive them are not yet erected.

The work of handling these heavy pieces of machinery is made easy by the great electric travelling cranes, three of which extend the entire length of the building. A machine is brought into the building on a car. The crane picks it up and carries it as near as possible to where it is to stand. It is then put on rollers and a stationary motor and drum draw it upon its foundation. It is hoped that the greater part of the load now carried by the temporary power plant can be transferred to the permanent plant by the middle of March.

The contract has been awarded for the iron work for the mammoth switchboard, and the work of erection has already begun. The marble tablets and instruments have been shipped from Pittsburgh and will soon be in place.

L. W. C.

FELIX STARKENBERG.

FELIX STARKENBERG, the Swedish inventor, who, two years ago, exhibited at the Battery a wave motor by means of which he proposed to generate electricity for light and power, died recently in Brooklyn. Failing to interest capitalists in his plan, he had turned his attention to a number of other novel mechanical devices, the last of which was just about to be introduced to the public when he died. It is understood that he leaves a large family with but scanty means of support.

SOMETHING NEW.

THE Columbus, S. C., *Register* states that "Trolley poles for the electric street railroad are being erected on Laurel street."

MISCELLANEOUS.

ELECTRIC POWER IN MILLS AND FACTORIES.

WHILE the employment of electric motors for driving machinery is common enough in isolated cases, where the electric motor takes the place of a small steam, gas or water motor, the advantages of equipping a large factory or mill entirely with electric power are only beginning to be appreciated by those interested in such works. Even now the plants so equipped, though small as compared with the number in which isolated motors are employed, have proven in actual practice the reliability and economy of this system of power transmission in factories, and a brief enumeration of its advantages will show beyond cavil, its superiority over all other methods.

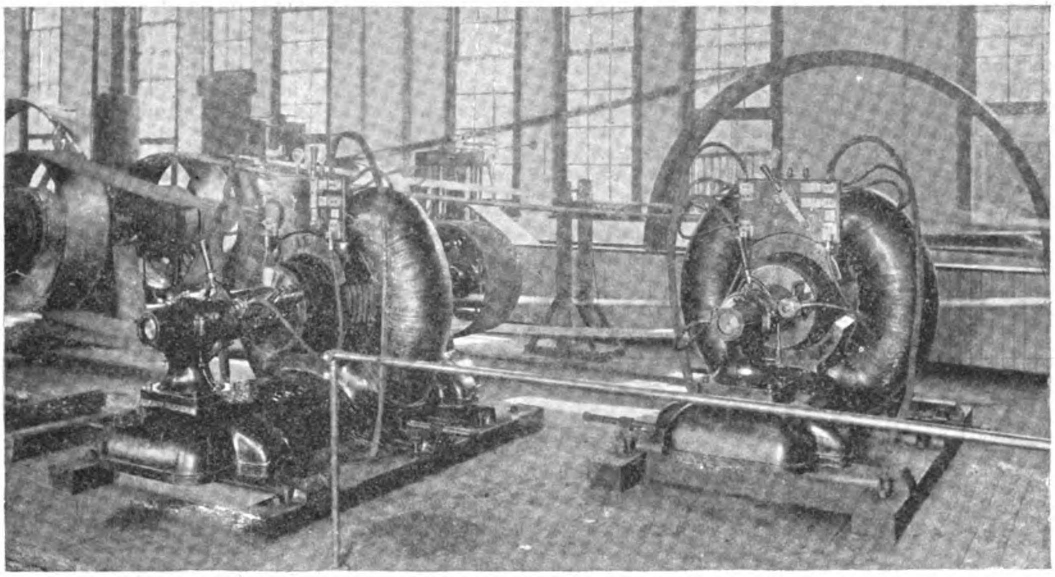


FIG. 1.—CENTRAL C. & C. ELECTRIC POWER PLANT, FRASER & CHALMERS, CHICAGO, ILL.

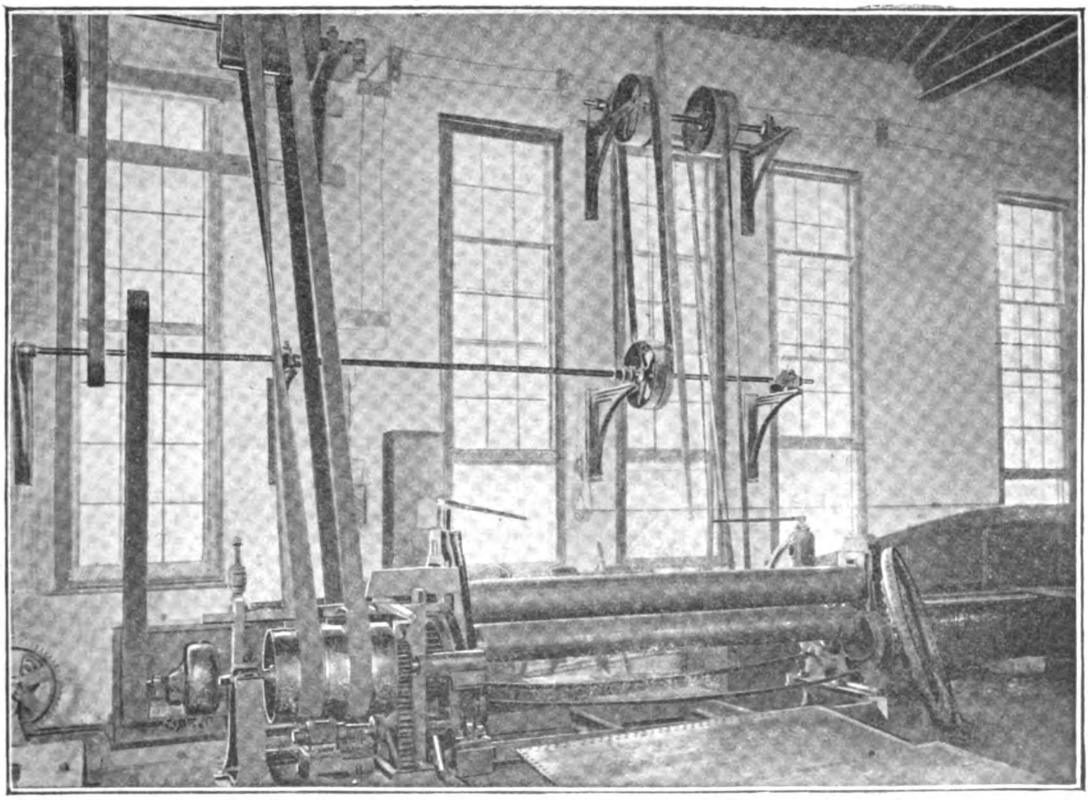


FIG. 2.—10-FOOT BOILER PLATE ROLL, OPERATED BY C. & C. MOTOR, FRASER & CHALMERS, CHICAGO.

The general practice in mill and factory power transmission involves the use of belting, shafting and gearing which must be kept in continuous motion whether 1 or 500 horse power is being actually consumed by the machines driven; it makes no difference whether one lathe or loom, or fifty, are in motion, the shafting must be always in operation. Now it has been proven by oft-repeated and reliable tests that from 25 to 50 per cent., of the entire power generated and consumed in factories and mills is absorbed in merely keeping the shafting and belting in motion. In other words, on this old plan it would take anywhere from 100 to 250 h. p. alone to keep the shafting in motion in a so-called 500 h. p. installation.

It is a matter of general observation that the machines in manufacturing establishments are not operated continuously, but on the contrary, are started and stopped at intervals varying from a few seconds to several minutes; and again, the very nature of some machines is such as to make the draft of power intermittent. Take for example a planer; here the full power may be required for 30 seconds at the cutting stroke, while the return stroke of the platen is accomplished in 10 seconds with an expenditure of but a small fraction of the power previously used. Under the old method of belting, the engine would not, as it were, feel this change, for the reason that it would take too long for so small a change in the entire power to travel back through counter, main and jack shaft to the engine, and affect the cut-off.

But with electric transmission the case is entirely different. Here all machines are driven individually by motors deriving current from a dynamo driven directly from the engine. Hence, the instant a machine stops,—or as in the case of a planer, its power consumption is reduced,—the current required by the motor is correspondingly reduced; this reduction of current is immediately felt by the generating dynamo and the cut-off of the engine in turn at once operates to reduce the steam consumption. The saving in steam naturally means a corresponding saving in the coal pile. Another point worth noting is that whereas the loss in shafting is practically constant for all loads, with electricity the loss in the wiring decreases with light loads. Thus if a circuit is designed for a loss of 1 h. p. when carrying full load the loss will be only about ¼ h. p. at half load.

Among electrical manufacturers who early realized the facts above cited are the C. & C. Electric Motor Co., of this city, who demonstrated their faith in the correctness of the principle involved by equipping their own factory in this manner some years ago. Here five floors, filled with machinery, are operated by motors, a small conduit running up the side-wall carrying the circuits to the various departments, from the dynamo in the basement.

Among the notable plants of this nature recently installed by the C. & C. Co. is that in the enormous works of Messrs. Fraser & Chalmers, manufacturers of mining machinery, engines, boilers, etc., at Chicago. At the present time only a portion of the contemplated works are in operation, the rest being in process of construction. The power house is located away from the main buildings and near the centre of the works, and from here there are run three circuits delivering current with a loss of from 2 to 5 per cent. to the foundry, pattern shop and boiler shop, the only buildings thus far completed. Our engraving, Fig. 1, shows a view in the power house in which are located two C. & C. 80 k. w. standard compound dynamos driven by two Fraser & Chalmers' Corliss engines. These dynamos are designed to deliver current at 250 volts, regulating automatically for all loads, and supply power and incandescent lights for the entire works.

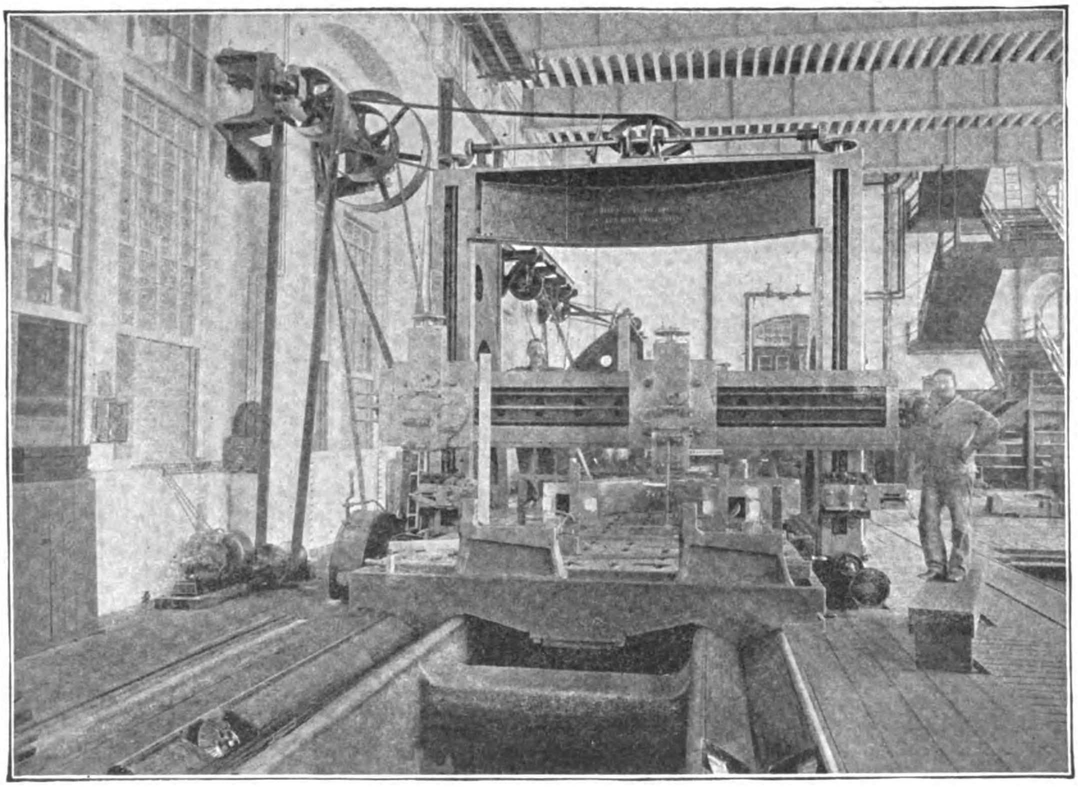


FIG. 3.—10-FOOT PLANER OPERATED BY C. & C. MOTOR, DE LA VERGNE REFRIGERATING MACHINE CO., NEW YORK.

But in addition to these vital points of economy there are others of hardly less importance; thus the cost of renewal and keeping in order of shafting and belting can be reduced to a small fraction by electric distribution. Again, on the score of convenience this method must be conceded to be *facile princeps.* Thus, with electric power any part of the works can be run independently of the rest, the mere throwing of a switch serving to cut off the power; as compared with the operation and cost of clutches required by the old method, the switch is toy-like in its simplicity. Again, by the electric method power may be obtained at any point, however distant, with the greatest facility. This fact is of special importance in factories and shops where portable tools, such as drills, must be applied to heavy work, and which can readily be carried out by the aid of the electric method of transmission.

If to all these advantages we add, that light and power can be had from the circuits; that the power generating station can be placed at a considerable distance from the factory proper, and thus reduce the fire risk, or to take advantage of a waterfall, for instance; that the power consumed by any machine or any number of machines can be readily ascertained by means of a recording wattmeter and that the application of electric power is accompanied by perfect cleanliness,—then it will be admitted that it is only a question of time when this mode of power transmission will be the preferred one in well-designed factories.

In the foundry there is operated a 65 h. p. motor running a No. 6 and a No. 4 Root blower, supplying blast for the cupola furnaces. Here is also a 4,000 lb. Reedy elevator driven by a 20 h. p. motor. For handling heavy castings, moulds, etc., there is a Yale & Towne jib crane worked by two standard C. & C. motors. The hoisting and lowering motor is of 7½ h. p. capacity, working up to 12 h. p. maximum and the trolley motor is of 5 h. p.

The power equipment of the pattern shop consists of a 25 h. p. motor, and a 20 h. p. motor, which run a 24-inch planer, cross cut and rip saws and 2 band saws; also 4 lathes and 1 grind stone. There is also a 15 h. p. motor running an elevator in this department.

The boiler shop contains a great deal of heavy machinery, and the freedom from line shafting and counter belts is noticeable. Most of the machines are divided into groups of 2 or 3 driven by one motor, though in some cases there is a separate motor for each machine. This shop contains the following machinery: One 5 h. p. motor running boiler-plate shear and large upright drill; one 10 h. p. motor running large hand punch, bevel shear, turret lathe and 16-inch shaper; one 10 h. p. motor running slitting shear and large boiler-plate punch; one 5 h. p. motor running boiler-plate punch, shear and small vertical drill; one 10 h. p. motor running 10 foot boiler-plate roll and 20 foot plate planer; one 10 h. p. motor running a Williams, White & Co.'s bulldozer; one 10 h. p. motor running a large bevel shear, upright drill and punch; one

5 h. p. motor running 2 sets of 5 foot sheet iron rolls and automatic sheet iron punch ; one 5 h. p. motor running a No. 1 Root blower supplying draught for forge fires.

Our engraving Fig. 2, gives a view of the 10-foot boiler-plate roll, and shows the method of connecting the motors to their work. The motors throughout the shops are provided with automatic cut-off starting switches, so that when the current is cut off at the main switch-board, each motor is cut off from its circuit. This prevents the possibility of injury to motors from the current being suddenly thrown on them from the power house.

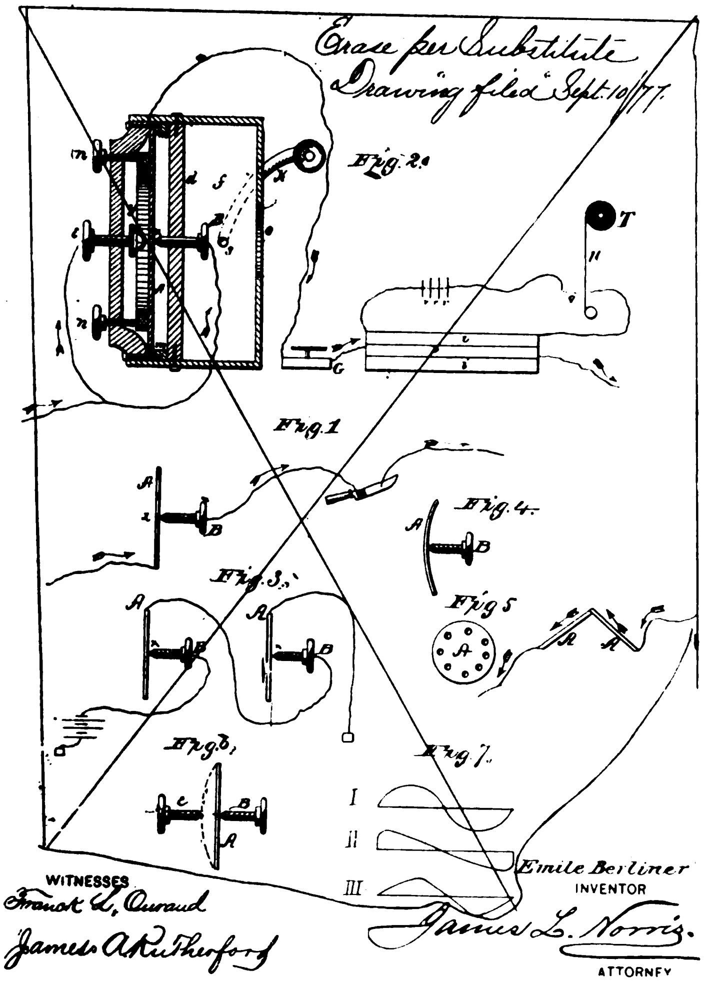
Among other large works equipped on this system by the C. & C. Co., are those of the De La Vergne Refrigerating Machine Co., of this city, which are fitted throughout with electric motors. Our engraving Fig. 3 shows a 10-foot planer in these works driven by a 10 h. p. C. & C. motor. The Brooklyn Cooperage Works, of Brooklyn, N. Y., have also been similarly equipped.

The C. & C. Electric Motor Co., who have been the pioneers in this class of work, have met with complete success in all the plants so far equipped by them and are, we think, justified in the belief that in this direction alone lies a field worthy of the best energies of electrical engineers and manufacturers. The company has now in press a profusely illustrated catalogue, describing in detail the work they have accomplished in this direction.

LEGAL NOTES.

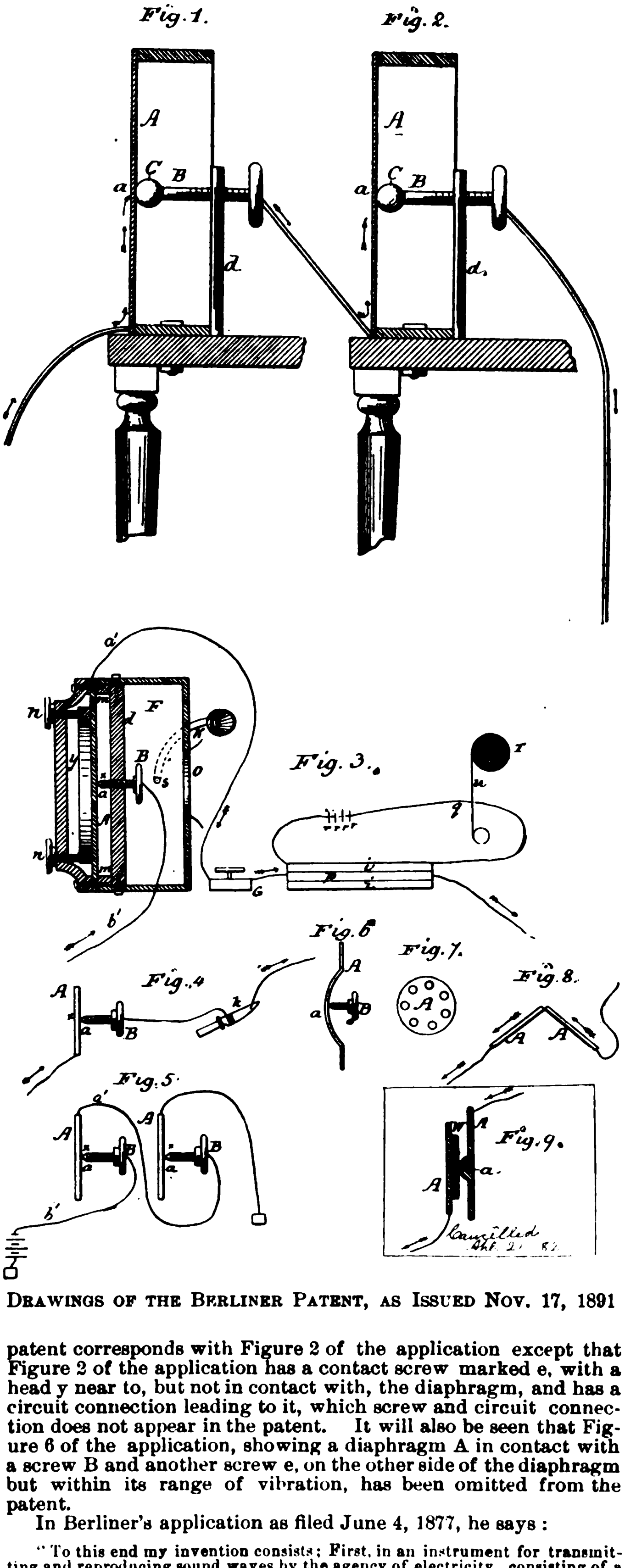
GOVERNMENT SUIT TO ANNUL THE BERLINER TELEPHONE PATENT.—II.

IN its issue of February 22 THE ELECTRICAL ENGINEER pointed out the allegation of the Attorney General's bill that Berliner's application of June 4, 1877, described a *make and break* transmitter, and that it did not describe any other kind of transmitter ; and that in the patent as issued (November 17, 1891) the *make and break* transmitter had been eliminated and a *constant contact* transmitter had been substituted.



DRAWING FILED WITH BERLINER'S APPLICATION, JUNE 4, 1877.

Below are reproductions of the drawings of the original application and those of the amended application and of the patent. It will be seen that Figures 1 and 2 of the patent are not found in the application. It will also be seen that Figure 3 of the patent corresponds with Figure 2 of the application except that Figure 2 of the application has a contact screw marked e, with a head y near to, but not in contact with, the diaphragm, and has a circuit connection leading to it, which screw and circuit connection does not appear in the patent. It will also be seen that Figure 6 of the application, showing a diaphragm A in contact with a screw B and another screw e, on the other side of the diaphragm but within its range of vibration, has been omitted from the patent.



DRAWINGS OF THE BERLINER PATENT, AS ISSUED NOV. 17, 1891

In Berliner's application as filed June 4, 1877, he says :

> "To this end my invention consists; First, in an instrument for transmitting and reproducing sound waves by the agency of electricity, consisting of a metallic diaphragm or other vibratory medium, connected to or forming part of one pole of an electric circuit, arranged in contact with the opposite pole thereof and capable of being put in vibration by the action of the electric current, as more fully herein set forth.
>
> * * * * * *
>
> Third, in the combination with said vibrating diaphragm of a pin arranged *out of contact* with the same but *within its field of vibration* and in the same

electrical circuit for producing and transmitting *special sound-waves*, as more fully hereinafter set forth.

* * * * * *

If now the plate of one instrument, as in Fig. 3, is vibrated by sound-waves, which happens whenever any kind of sound is uttered or produced by musical instruments in its neighborhood, every wave or vibration that strikes the plate will cause a weakening of the point of contact; or also if the sound is sufficiently strong, a break of the electric current at that point.

These simple instruments will produce any musical sound uttered in the neighborhood of one of them; but for the reproduction of special sounds, *such as speech, they are not adapted* for the following reasons:

* * * * * *

It is therefore evident that the apparatus described thus far can but transmit a pure musical sound because it transmits only the number of vibrations per second which is equal to the lengths of the waves, but nothing of the nature of each wave and the shape of their curves is recorded. *This I accomplish, however, by situating within the vibration field of the plate A a second screw e.* In Fig. 6 the dotted line indicates the vibrating field of the plate B, the screw in contact with the plate, and e the second screw. It will now happen in special sounds (meaning the nature of every sound besides its certain musical pitch) that the plate will not always strike the screw e in the middle of the duration of one wave or vibration, and taking for instance the duration of one wave to be one minute, the plate in special sounds will sometimes strike the screw e, sometimes after twenty or twenty-five seconds from its beginning. This now is exactly recorded on this secondary screw e, which also makes an electric connection whenever the plate A touches it, and at the receiving apparatus these special sounds will therefore be noticed. I have thus succeeded in producing a great many special sounds, such as the vowels and others. The principle of producing special sounds by *break and make of contact* rests mainly in the use of this secondary contact screw.

* * * * * *

What I claim and desire to secure by letters-patent is;

* * * * * *

4. In combination with the metallic diaphragm and its contact pin, a secondary pin out of contact with said diaphragm but within its vibratory field, and the same electric circuit, the whole adapted to operate as set forth for transmitting special sounds."

None of the matter quoted above appears in the patent. The following is quoted from the patent as issued (none of which appears in the application as filed):

"It is a fact that if at a point of contact between two conductors forming part of an electric circuit and carrying an electric current, the pressure between both sides of the contact becomes weakened, the current passing becomes less intense, as for instance if an operator on a Morse instrument does not press down the key with a certain firmness the sounder at the receiving instrument works much weaker than if the full pressure of the hand had been used. Based on this fact I have constructed a simple apparatus for transmitting sound along a line of an electric current in the following manner. In figures 1 and 2 of the drawings A is a metal plate well fastened to the wooden box or frame, but able to vibrate if sound is uttered against it or in the neighborhood of said plate. Against the plate and touching it is the metal ball C, terminating the screw-threaded rod B, which is supported by the bar or stand d The pressure of the ball C against the plate A can be regulated by turning the rod B. The said ball and plate are included in circuit with an electric battery so that they form electrodes, the current passing from one of them to the other. By making the plate vibrate the pressure at the point of contact a becomes weaker or stronger as often as vibrations occur, and the strength of the current is thereby varied accordingly, as already described. By placing now, as is shown in the drawings, one such instrument in the station Fig. 7 and another instrument capable of acting as a telephonic receiver in the station Fig. 2, both situated on the same electric circuit in which a current is passing (as shown by the wire connections following the arrows) sound uttered against the plate of the instrument Fig. 1 will be reproduced by the plate of the instrument Fig. 2, for as the vibrating of the transmitter Fig. 1 caused by the sound will alternately weaken and strengthen the current as many times as vibrations occur, the diaphragm of the receiver will be caused by these electrical variations to vibrate at the same rate and measure. * * * * *

The important claims of the patent (1, 2, 3, and 6) are as follows:

1. The method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described.

2. An electric speaking-telephone transmitter operated by sound-waves and consisting of a plate sensitive to said sound-waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate.

3. The combination, with the diaphragm and vibratory electrode, of a rigidly held opposing electrode, in constant contact with the vibratory electrode, substantially as described.

* * * * * *

6. A speaking-telephone transmitter comprising a diaphragm or disc sensitive to sound-waves, combined with a rigidly-held but adjustable electrode in contact with the same, whereby the electric current is transformed into a series of undulations corresponding with the vibrations of said diaphragm.

In its SUPPLEMENT of November 17, 1891, the day on which the patent was issued, THE ELECTRICAL ENGINEER said:

"The claims of the Berliner patent appear to be of a very broad character, and to cover an essential element in about all the transmitters employed in telephone service. * * *

"The famous interference case [Berliner-Edison] has been a theme of much curiosity and interest now these many years; little has been publicly known of its status beyond its apparent immobility. Commissioner Simonds decided against Drawbaugh, who was a party, a few weeks ago. That decision is said to have cleared the way for the allowance and issue of the Berliner patent of this day.

"It is too early to undertake any critical examination of the patent or to express an opinion as to its scope. Should it be found broad enough to control the use of all practicable microphones, it is considered doubtful, in view of the circumstances of the long delay in its issue, whether the United States Courts would sustain it to the extent of permitting its owners to enjoy its protection for the next seventeen years."

LETTERS TO THE EDITOR.

MARCH 7, 1893, HOW ABOUT TELEPHONES?

THE fundamental Bell Telephone, patent No. 174,465 of March 7, 1876, expires on March 7, 1893. What effect the expiration of this patent will have, involves a number of factors and situations which I have not thus far seen intelligently analyzed in any of the electrical journals, notwithstanding the near approach of the above-mentioned date. The popular impression seems to be that the patent of March 7, 1876, is for the telephone receiver, and that the latter will be free after the expiration of that patent. It seems more than likely that telephone receivers may be bought and sold with impunity, and be essentially free. It is not true, however, that the patent of March 7 is upon the telephone receiver as we know it to-day; the last claim of this patent involves broadly the art of the transmission of speech by the use of an undulatory current of electricity. The Bell patent, No. 186,787 of January 30, 1877, is the one which covers the telephone as an instrument, and apparently no commercial telephone can be constructed which does not infringe this patent.

It may then well be asked how is it that preparations are being made by so many individuals and companies to sell telephone receivers and in some cases to organize and operate exchanges after March 7. There are a number of reasons that may explain this. In the first place, the British patent, No. 4,765, of December 9, 1876, includes, almost verbatim, all the claims of the United States patent of January 30, 1877, and being a prior patent would seem to have invalidated the American patent after December 9, 1890, when it expired. As, however, the British patent, dated December 9, 1876, was not sealed until the following May, it may be claimed that it was not really a patent before that time, and, therefore, could not be construed as being a prior British patent. A number of decisions have been made by the courts which would seem to uphold this view of the case although the question never has been carried to the Supreme Court. Again, the only novelties covered by the second patent are the use of the permanent steel magnet and a diaphragm of iron or steel or other metal susceptible of inductive influences. The other claims of the patent seem either immaterial or to involve practically a repetition of the claim before mentioned in the patent of 1876. In fact, any possible telephone devised in accordance with the specifications and claims of the first patent would infringe the first claim of the second, which is drawn so broad as practically to patent the practical principles of the telephone all over again and thereby extend the monopoly in receivers.

Is it likely that the American Bell Telephone Company will be able to secure an immediate preliminary injunction against manufacturers of telephone receivers by virtue of existing decisions in its favor and legal precedents? If such an injunction can be procured, the telephone receiver is certainly tied up till January 30, 1894; if, however, such an injunction cannot be immediately obtained, if there be opportunities for argument and delay, as would seem likely, we may look for the purchase and sale outright of telephones in increasing quantities from day to day after March 7 as the public confidence is secured. The second patent, having only 10 months to run, it seems to be thought by those about to engage in the business, that a suit for infringement could not possibly be decided in so short a time and that the damages to be claimed, even in the event of an adverse decision, would not be commensurate with the advantage of establishing business in the meantime. Rumors are current that the American Bell Telephone Company will resurrect some of its best forms of magneto transmitters, of which it has several excellent ones, and sell them, with receivers, outright after March; if this can be done with justice to the licensee Bell companies, it would apparently be a shrewd move for the reason that the Bell Company could get better price for its instruments than the new strugglers in the field, owing to the desire of the public to purchase what it can use in peace and tranquility. A merchant would naturally, in view of the intricacies of the patent situation, rather pay the Bell Company $10 for a good set of instruments for private or speaking-tube service, than purchase similar instruments from others at, say $5 per set; especially as he would doubtless in this case receive the best magneto transmitter on the market. It is thought by some that little attention will be paid hereafter by the Bell people to the manufacturers of receivers for private line and speaking-tube purposes, but that operators of incipient exchanges will have the honor of drawing the heaviest legal fire from Boston.

It does seem problematical whether the manufacturers of receivers already starting up can be suppressed during the next 10 months, even by the promptest and most successful action of the Bell Company and the coöperation of the courts. As yet, no one has had the temerity to offer for sale, in the United States, a carbon or other battery transmitter, although telephones by the thousands are said to be ready for sale after March 7. However, the very moment the Bell Company shall fail to get its first injunction against a manufacturer or user of receivers, it seems more than likely that carbon transmitters, whose infringement of the Berliner and Edison patents is doubtful, will appear for sale, and thus will probably be the signal for a legal battle as important, far-reaching, and doubtless as long strung out, as the incandescent lamp litigation. If millions of incandescent lamps have been used during the years of the litigation establishing Edison's right to the invention, how many telephones and transmitters will be in operation before the Bell Company shall have won or lost its next great battle?

The construction and operation of telephone lines are apparently much less formidable undertakings in respect to cost and maintenance than in the case of electric lighting.

I learn from THE ELECTRICAL ENGINEER of February 22, that United States Attorney-General Miller has already taken steps on the part of the Government to annul the Berliner patent, which lay in the Patent Office some 13 or 14 years after application before it was issued.

Summing up the situation, it would appear to me that owing to the splendid and permanent establishment of the licensee Bell companies throughout the country, the superiority of their apparatus, the hundreds and perhaps thousands of patents on important details, owned by them and the Western Electric Company, together with their magnificent system of interurban communication, any new company contemplating the establishment and operation of exchanges will labor under serious disadvantages. On the other hand, the opening of private line service to the public will be a blessing to the various electrical supply and construction companies and to the electrical trade in general; for the reason that it will bring such companies into profitable contact with thousands of new customers who will be willing to pay for good work and who will pay surely and promptly. As I said before, it seems strange that no discussion of any value, of this question, has a yet even commenced in any of the electrical journals and as the foremost electrical journal published in this country, I have taken the liberty of addressing THE ELECTRICAL ENGINEER on this subject, with the hope of eliciting its opinion and drawing out the views and predictions of others.

CONSERVATIVE.

[OUR correspondent, whose letter arrives just before going to press, seems to have set forth the existing situation in respect to the telephone business and telephone patents with tolerable completeness and to have answered, in great part, the queries suggested by his letter. He probably does not expect us to assume to decide the patent questions involved in advance of their legal solution by the Courts, or to advise manufacturers to rush into the telephone field. There is no doubt, however, that the time is near at hand when competing telephones will be on the market.

EDS. E. E.]

STEADY SPEED FOR DYNAMOS.

WE are looking for a contrivance to give a dynamo steady speed from a variable one. Can you give us any information?

W. S. CHESLEY & CO.

24 Morris street,
JERSEY CITY, N. J.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED FEBRUARY 14, 1893.

Accumulators:—

Manufacture of Secondary Battery Electrodes, R. McA. Lloyd, New York, N. Y., 491,684. Filed Sept. 30, 1892.

Consists in subjecting a plate to the action of a solution at first acid and afterward becoming alkaline; thus first producing honeycombs in the surface of the plate and subsequently chemically depositing thereon active material.

Accumulator, W. A. Macleod, Boston, Mass., 491,726. Filed Dec. 17, 1890.

Consists of porous plates supporting the active material and having apertures passing inward from the edges.

Secondary Battery, N. H. Edgerton, Philadelphia, Pa., 491,878. Filed July 11, 1892.

Consists of a series of independent frames unsusceptible to the action of electricity, each provided with a metal plate; those in the end frames provided on one side with a layer of active material and the intermediate ones with active material on both sides.

Alarms and Signals:—

Electrical Signaling Apparatus, J. B. Currier, Lowell, Mass., 491,531. Filed Dec. 15, 1881.

A signaling system having a series of individual call bells and an automatically selfadjusting regulator interposing the air bridge in the circuit to prevent an excess of current.

Electric Governor for Signaling Circuits, J. B. Currier & D. H Rice, Lowell, Mass, 491,532. Filed Dec. 1, 1882.

Escaping Gas Alarm, O. J. Milligan, Chicago, Ill., 491,580. Filed July 23, 1892.

Time Circuit Closer, R. H. Twigg, London, England, 491,692. Filed Aug. 9, 1892.

Track Circuit, J. B. Stewart, Haverstraw, N. Y., 491,609. Filed Nov. 5, 1892.

An electric block system for steam railways.

Electric Signaling Apparatus, L. von Orth, Berlin, Germany, 491,758. Filed Apr. 14, 1892.

A system by means of which predetermined signals may be sent over telephone or other wires without impeding the traffic upon them.

Electric Alarm Money Drawer, W. J. Walker, St. Louis, Mo., 491,824. Filed Oct. 29, 1892.

Railway Train Order and Signaling Device, L. T. Crabtree, New London, Wis., 491,887. Filed Apr. 2, 1892.

Electric Signal, F. H. Clarke, Springfield, O., 491,874. Filed Oct. 24, 1892.

An electric block system for steam railways.

Conductors, Conduits and Insulators:—

Electric Motor and Dynamo Mica Insulator, C. W. Jefferson, Schenectady, N. Y., 491,708. Filed June 1, 1892.

A disc for insulating armature heads consisting of concentric rings of mica scales radiating from the centre, overlapping and cemented at their edges.

Insulator, Louis McCarthy, Boston, Mass., 491,729. Filed Aug. 8, 1892.

Consists of a case containing a connecting piece, insulating material separating the one from the other, and a cap secured in place by turning the case over its edges.

Insulator, A. L. Johnston, Richmond, Va., 491,890. Filed May 4, 1892.

An insulator provided with a well containing non-conducting liquid and having a wire hanger suspended therein.

Dynamos and Motors:—

Conductor for Armatures, E. Kolben, Schenectady, N. Y., 491,567. Filed Feb. 8, 1892.

A U-shaped bar conductor forming part of an armature coil and having one limb wider than the other with a radial saw-kerf dividing the wider limb for a part of its length.

Armature and Means for Supporting the Same, E. Kolben, Schenectady, N. Y., 491,568. Filed Feb. 8, 1892.

Consists of a ring supported upon spider arms, an armature conductor surrounding the arm, special conductors crossing the sides at the spider arms, and special conductors connected across the inner surface of the armature.

Alternating Current Dynamo Electric Machine, J. J. Wood, Brooklyn, N. Y., 491,695. Filed Oct. 30, 1890.

Employs an armature consisting of an annular core of magnetizable metal without polar projections and having two supporting rings fastened against its opposite sides and a succession of flat coils arranged against the inner surface of the core.

Alternating Current Generator, O. Patin, Paris, France, 491,811. Filed July 8, 1892.

A generator adapted to be placed directly upon the shaft of the engine in place of the fly-wheels.

Electric Motor Regulator, J. A. Williams, Canal Dover, O., 491,829. Filed Feb. 11, 1892.

A centrifugal governor having a spindle provided with a pair of friction discs and a brush-carrying arm with a toothed sector; in combination with a shaft parallel to the driving shaft and geared to the sector, and a sliding frame in which one end of the shaft is mounted and carrying a transverse shaft geared with a friction disc between the parallel discs before mentioned.

Electric Motor, A. W. Meston, St. Louis, Mo., 491,970. Filed June 15, 1891.

A motor designed to be actuated by constant or alternating current which shall be self-starting and have a positive directive tendency of rotation at all speeds, and with constant potential current self-regulating for speed.

Lamps and Appurtenances:—

Electric Arc Lamp, F. D. A. Goold, Schenectady, N. Y., 491,548. Filed Apr. 15, 1892.

Invention relates to mechanism for controlling the movement and regulation of the carbon rod.

Incandescent Lamp Socket, J. Hutchinson, New York, 491,561. Filed June 11, 1891.

Electric Lamp Fixture or Bracket, J. T. Robb, Mt. Vernon, N. Y. 491,596. Filed Aug. 31, 1891.

Duplex Electric Arc Lamp, C. E. Scribner, Chicago, Ill., 491,603. Filed Oct. 27, 1890.

Provides for burning lamps in groups of two upon the same circuit, the different members or pairs of a group being provided with the necessary circuits and mechanism to cause one lamp to burn before the other.

Electric Arc Lamp, C. E. Scribner, Chicago, Ill., 491,604. Filed Oct. 30, 1890.

Claim 1 follows:

A direct shunt around an electric lamp, said shunt containing a circuit closer, in combination with the carbon rod and a yielding guide for the carbon rod adapted to maintaining said cut-out opened or closed accordingly as the weight of the rod is placed upon or removed from the said yielding guide.

Cut-Out for Arc Lamps, C. E. Scribner, Chicago, Ill., 491,605. Filed Dec. 1, 1890.

Provides automatic means for closing a circuit around the lamp when the carbons cease to feed or are consumed.

Bushing for Incandescent Lamp Sockets, C. A. B. Halvorson, Saugus, 491,682. Filed Apr. 4, 1892.

Electric Head Lamp, W. Main, Brooklyn, N. Y., 491,718. Filed Oct. 29, 1892.

Electric Arc Lamp, W. H. Akester, London, Eng., 491,915. Filed Sept. 9, 1892.

Employs two carriers for the carbons connected by means of a flexible connection, a pulley loosely mounted from a shaft over which the flexible connection passes and a spring for normally holding the pulley shaft in a given position.

Electric Arc Lamp, W. H. Akester, London, England, 491,916. Filed Sept. 9, 1892.

Similar to 491,915.

Measurement:—

Coulomb Counter, G. Hummel, Nuremberg, Germany, 491,560. Filed Feb. 16, 1891.

A coulomb meter based upon the principle of mutual dynamic action between a fixed and movable electric conductor.

Miscellaneous:—

Ore Amalgamator, F. O. Norton, Clinton, O., 491,686. Filed Dec. 31, 1891.

Method of Electrolytically Producing Soda and Chlorine, E. B. Cutter, New York, N. Y., 491,700. Filed Dec. 30, 1891.

Method of Electrolytically Producing Potassium Chlorate, E. B. Cutter, New York, N. Y., 491,701. Filed Apr. 11, 1892.

Self Winding Electric Clock, E. Klahn, West Hoboken, N. J., 491,945. Filed Feb. 17, 1892.

Railways and Appliances:—

Electric Locomotive, S. H. Short, Cleveland, O., 491,666. Filed Jan. 16, 1891.

Employs a motor whose armature is axially placed with reference to a car axle and directly connected with it, and having cushioning material between the axles and the tires.

Directly Connected Motor for Cars, S. H. Short, Cleveland, O., 491,667. Filed Mar. 30, 1891.

Similar to 491,666.

Series System for Railways, G. L. Thomas, Brooklyn, N. Y., 491,691. Filed June 16, 1892.

Invention contemplates a single line wire posted along the path of the moving vehicle and adapted to be intercepted by the vehicle to make with an insulating circuit within the vehicle a part of the single line circuit.

Electric Locomotive, F. B. Rae, Detroit, Mich., 491,857. Filed Apr. 11, 1891.

Relates especially to the manner of mounting the motor and connecting it with the running gear.

Telegraphs :—

Telegraph Transmitter, R. S. Roberts, Philadelphia, Pa., 491,595. Filed 29, 1892.

An automatic transmitter employing two angle levers, an axle journaled in and supporting the levers and transmitter, and a wheel mounted on the transmitter; the axle and transmitter being insulated from the other parts of the instrument.

Telephones and Apparatus :—

Trunk Line Signaling Apparatus and Circuit for Telephone Exchanges, E. J. Hall, Morris, N. J., 491,558. Filed Oct. 13, 1892.

Employs a divided switchboard, a double conductor trunk circuit and office trunk conductors with inter-station trunk conductors, fitted with a reciprocal signaling system whereby connections and disconnections at either end are indicated at the other.

Switching System for Telephone Exchanges, C. E. Scribner, Chicago, Ill., 491,688. Filed May 19, 1892.

Memorandum Tablet for Telephones, W. M. Kleeman, Columbus, O., 491,777. Filed Apr. 11, 1892.

Telephone Call, J. H. Kinsman, Bridgeport, Conn., 491,898. Filed Jan. 20, 1892.

INCANDESCENT LITIGATION.—THE NEW WESTINGHOUSE LAMP.

THE Westinghouse company having been enjoined December 27, 1892, in the U. S. Circuit Court, at Pittsburgh, from making lamps infringing the second claim of the Edison patent—in accordance with the Appellate Court decisions in New York against the United States and Sawyer-Man companies, soon after put upon the market their new "stopper lamp" as a lamp not infringing the Edison patent, and on February 1, presented an affidavit to the same court, setting forth these facts, and obtained a rule upon the plaintiffs, Edison Electric Light Co. *et. al.* [General Electric Co.] to show cause why the injunction should not be so construed, or restated as to leave defendants free to make, use and sell their "stopper lamps." The plaintiff moved the court to reverse this rule, and the case was argued by counsel on both sides a week later. [See THE ELECTRICAL ENGINEER, February 15].

On February 23 the Court (Acheson, *Cir. J.* and Buffington, *J.*) handed down on opinion, by Judge Acheson, from which the following is quoted:

"While we are quite prepared to accept the defendants' course in taking this rule as evidence of their good faith to the Court, and as indicating a purpose to avoid even the appearence of any wilful disobedience to our writ of injunction, yet, under all of the circumstances we think it would be going too far at their instance and in this summary way, to enter upon the consideration of the question whether the lamp now submitted to us infringes the patent in suit. This lamp was not before the Courts of the Second Circuit, and the question of infringement involved in this rule is entirely new. Undoubtedly there is a marked difference in structure between this stopper-lamp and lamps such as Exhibits Nos. 1, 2, and 3 which we have specifically enjoined, but enough appears to satisfy us that the question of infringements cannot be determined safely upon a mere inspection of the lamp. No investigation would be complete without the aid of expert testimony and evidence touching the art of electric lighting in its earlier stage, But *ex parte* affidavits upon these subjects (and this rule contemplates nothing more) would be most unsatisfactory. Moreover, should the rule go to hearing on the merits, the action of the Court thereon would be inclusive.

But furthermore, if the question whether the defendant's stopper lamp infringes the second claim of the patent in suit can properly be considered at all upon a mere rule to show cause, the party invoking the rule, we think, should be the plaintiff, to whom it is, of course, open to apply for an attachment against the defendants for the alleged violation of our injunction. In the absence of such an application by the plaintiff, the consideration of this question must await the final hearing. Then we may be called on regularly and properly to decide the question, for clearly the relief obtainable under the present bill is not limited as respects either an injunction or an account to infringing lamps made before the institution of the suit, but equally embraces those made afterwards although structurally different from the former ones. *Story's Eq. Pl.* Sec. 352; *Knox* v. *The Great Western Q. M. Co.*, 5 Saw. 430; *Rubber Co.* v. *Goodyear*, 9 Wal. 788.

The rule to show cause granted February 1, 1893 will therefore be discharged, but without prejudice to the defendants' rights to set up in their answer the matters upon which said rule was founded.

And it is so ordered.

WESTINGHOUSE ELECTRIC RAILWAY WORK.

ORDERS for electrical railway equipment taken by the Westinghouse Electric and Manufacturing Co., since January 1, amount to nearly $2,000,000. It is reported that the company has orders for about 4,000 street railway motors.

THE BOUGHTON TELEPHOTOS.

ON the evening of Feb. 9th, the members of the Buffalo Electrical Society and their friends were entertained by Mr. C. V. Boughton, the inventor of the "telephotos" at his works on Seventh St., Buffalo.

The "telephotos" is designed for the purpose of communicating between ships at sea, armies in the field, and for other similar purposes now usually accomplished by means of rockets, flags and other visual devices. Among the advantages claimed for Mr. Boughton's invention is the facility with which such communications can be effected, the compactness of the apparatus, which permits of easy of transportation, and the unlimited scope of the communications. The Morse telegraphic code of dots and dashes is employed for signals which are produced by means of incandescent lamps, operated by dynamo currents and controlled by a key-board on which the characters are designated or marked by Roman letters, thus enabling any one, whether familar with the Morse code or not, to transmit despatches, which must, of course, be received and translated by an attendant, expert in reading those characters.

The lamps employed to produce the dots and dashes are arranged in a vertical, or horizontal line and are of the ordinary 32 c. p. make. The lamps are placed in individual pockets with suitably arranged reflectors for projecting the rays of light. There are 106 of these lamps, two of which are glowed to produce a dot, 20 to produce a dash, and 20 intervening lamps left unilluminated to effect the space between the dots and dashes. 60 lamps are glowed for a long dash representing the cipher, or naught, and two red lamps denote a period.

The lamps are controlled by a key-board not dissimilar to the key-board of the conventional typewriting machine. The case is made of aluminum, to secure lightness, and is contained within an area of two and one half feet square, with a depth of six inches. The keyboard, comprising 37 letters, numerals, etc., occupies one foot and six inches; the remaining portion is taken up by the electrical connections, of which there are necessarily a large number. The manner in which the multifold connections necessary to energize the required number of lamps to produce any required letter when the key is depressed are made, is easily understood by imagining a flat commutator, having a segment for each lamp, against which is pressed a metallic bar covering all of the segments, on the face of which are gaps over the segments connected with the lamps not to be energized in producing the letter represented by the key depressed.

The keys are marked by letters and figures on rollers running across the keyboard which are simultaneously revolved by a thumbscrew and ratchet at the side of the machine. As each side of the rollers has a sequence of letters, etc., starting from a different letter of the alpabet, secret signaling is effected by a transposition of the alphabet and the code. When the rollers are in their normal position the letters correspond with the Morse characters produced, but when the rollers are turned, depressing the key designated by the letter "A" may cause the Morse "B" to be shown by the lights, or any other predetermined Morse character. Attached to the keyboard is a very ingenious and simple device, the invention of Mr. Boughton, which locks all the keys except the one depressed and prevents more than one key being depressed at a time. Mr. Boughton has also applied this device to typewriting machines, where it will fill a long felt want.

The key and the lamp boards are connected by a cable containing the requisite number of conductors, and may be of any length desired. The weight of the keyboard is about 75 pounds and that of the lamp frame 120 pounds. It is stated that the weight of a wagon all the apparatus necessary for field operation, including boiler, engine and generator, will not exceed 1,500 lbs. Mr. Boughton has demonstrated that his signals can be read at a distance of three miles by daylight and ten miles at night. He feels confident that these distances can be increased. The apparatus can be worked at a speed of fifteen words a minute, and has the advantage of greater scope and precision than any other method of signaling in vogue.

PARTRICK & CARTER COMPANY.

THE PARTRICK & CARTER COMPANY of 125 South Second Street, Philadelphia, report that they are having increased sales of their automatic set back annunciator, which has been described and illustrated in THE ELECTRICAL ENGINEER. Each new call registered upon this instrument resets the pointer, so that no confusion is possible, and the annoyance of resetting by hand is avoided.

The automatic annunciators are handsomely made in a variety of woods, and present an ornamental appearance, while their freedom from all complicated mechanism insures their durability.

THE PERU ELECTRIC MANUFACTURING COMPANY, of Peru, Ind., announce that Mr. P. C. Burns has severed his connection with them and disposed of all his interest in the company.

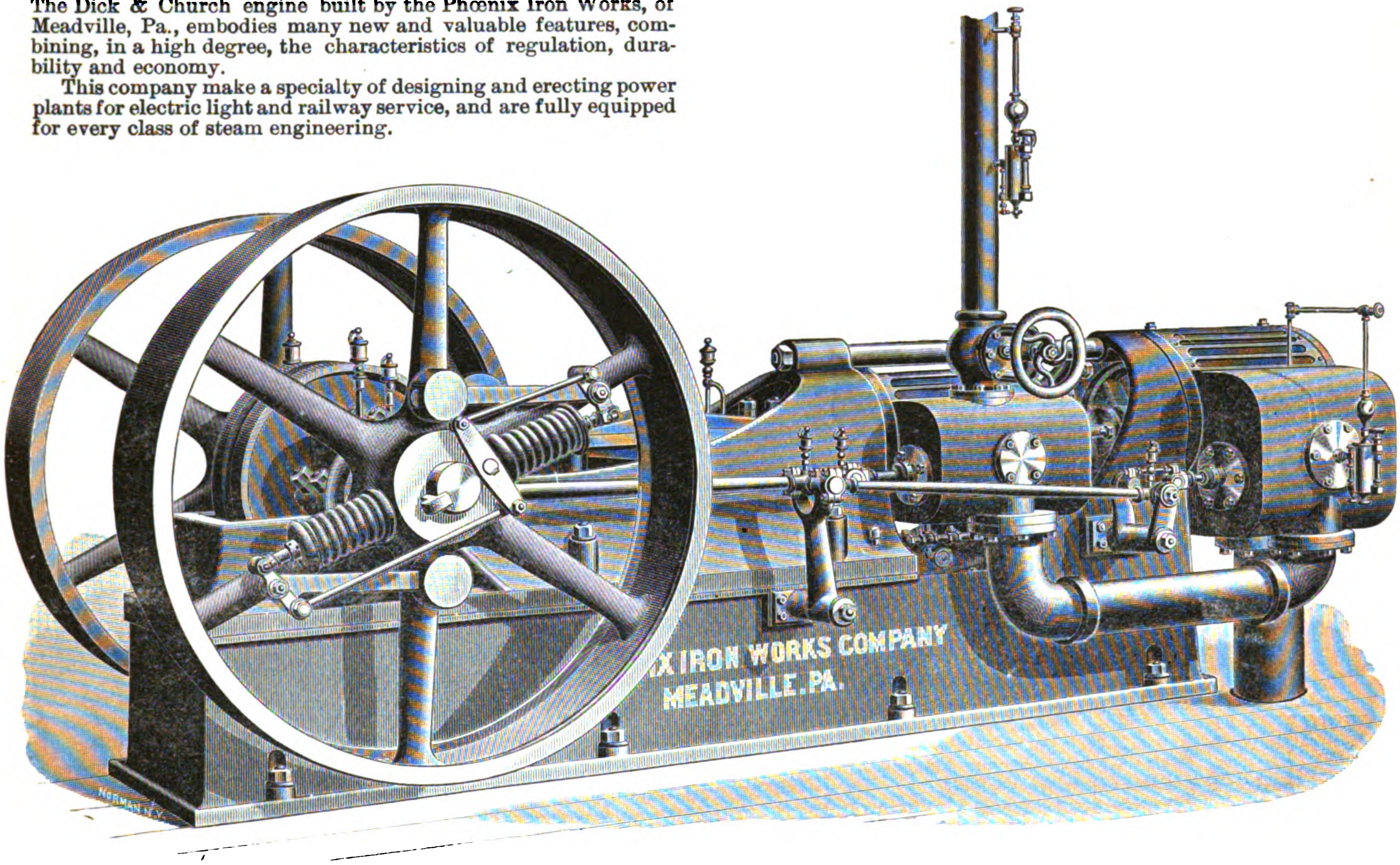
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE DICK & CHURCH ENGINE.

The introduction of the high speed automatic cut-off engine marks an important era in the development of the steam engine, particularly as it has so largely contributed to the successful development of the dynamo as a vehicle for the transmission of energy. No other type of engine has been able to fulfill the various and exacting conditions imposed, and the peculiar adaptability of the high speed engine to electrical work is now universally conceded. In spite of the arguments that have been advanced, in the past, against this type of engine, it has steadily increased in public favor, and the later developments have fully demonstrated that the high speed engine can show the very best results. The Dick & Church engine built by the Phœnix Iron Works, of Meadville, Pa., embodies many new and valuable features, combining, in a high degree, the characteristics of regulation, durability and economy.

This company make a specialty of designing and erecting power plants for electric light and railway service, and are fully equipped for every class of steam engineering.



The Dick & Church Tandem Compound Engine for Electric Lighting.

It is a well recognized principle in conducting all manufacturing and power producing plants that the measure of profit is more largely dependent upon the cost of the actual power production, than upon any other factor that enters into the economy of management, and it is therefore to the steam plant, as the prime motor, we must first look for results, as it is here the greatest loss generally occurs. The theoretical deduction that it is possible to expand the steam in a single cylinder, to a point so near the atmospheric pressure as to give the most economical results, has been shown to be fallacious by practical demonstration. This theoretical deduction does not take into account what practice has so clearly shown, viz., the wasteful condensation of steam in the cylinder, due to the excessive range of temperature between the boiler and exhaust pressure. It is for this reason that the limit of expansion in a single cylinder is soon reached, and experience has here demonstrated the advantage of the compound engine, an example of which is shown in the accompanying illustration, inasmuch as each cylinder is subject to a greatly reduced range of temperature variation, and also because of the diminished effect of clearance, retaining at the same time all the advantages of compression. The reduced initial thrust is also an important mechanical advantage in this type of engine, particularly in those of large powers. Not only in marine, but in stationary practice as well, is the compound engine rapidly taking the place of the single cylinder engine, as it has been found that the saving effected will amount to the entire extra cost in a short time. The actual first cost of a steam plant, with the compound engine, is little, if any, more than with the single cylinder engine, for much less boiler capacity is required and there is also a corresponding reduction in the other portions of the steam plant. These engines will be furnished adapted to run non-condensing when water for condensing purposes is not available, and while the saving in fuel is not as great, it is, nevertheless, so near that of the condensing engine, and so much in advance of the single cylinder engine, as to make its use imperative in all plants where fuel is a matter of any consideration.

THE ELECTRIC SELECTOR AND SIGNAL COMPANY.

With the assent of 99 % of the stock and bondholders of the Electric Secret Service Company, all of the property, patents, business and good will of that Company were sold by C. P. MacKie, Receiver, on February 11th, 1893, to the Electric Selector and Signal Company. This new corporation has likewise acquired other important inventions relating to the general subject of electrical selection, and proposes to develop this especial business as applied to telegraphs, block signals, electric light and power and telephones in this country and abroad, on a larger scale than the Company which it succeeds. The change has been effected without interruption of the business of the Electric Secret Service Company, and upon terms which provide for a settlement of all of that Company's obligations in full in cash. The Electric Selector and Signal Company will, we understand, have the same technical management as the Electric Secret Service Company, although its board of directors will contain several new and influential names.

CLARK ARC LAMP.

The Clark Electric Company, of 193 Broadway, manufacturers of arc lamps for both arc and incandescent circuits, have issued a new catalogue of their apparatus, including lamps, dynamos, regulators, etc. The lamps made by this company, especially designed for interior illumination, are got up in ornamental and graceful forms for the purpose, while those for out-of-door work are built for service and with an eye to simplicity of construction. The company have received a number of medals and many testimonials bearing witness to the excellence of their appliances.

NEW QUEEN MEASURING INSTRUMENTS OF PRECISION.

Queen & Co., Incorporated of Philadelphia have recently put upon the market some electrical measuring instruments, so original in design and efficient in use as to call for special mention. As it would be difficult at this time to mention all of this new apparatus, we shall confine ourselves to a description of two pieces which we consider most important in practical engineering.

Fig. 1 shows their new form of D'Arsonval galvanometer. The magnet is horizontal, circular in form, and built up of a number of discs stamped from sheet steel. The pole faces are shaped so as to give readings on a straight scale exactly proportional to the currents measured. The coil is long, narrow, and circular in cross section, and is fastened in an aluminum tube which forms part of the movable system. No iron core is used. The suspension tube is fitted with a movable bottom, which when raised lifts the coil so as to relieve the suspension, and clamps it tight. This prevents any injury during transportation. The whole suspension tube can be lifted out and replaced by another, automatic sliding contacts being made as the tube is put in position. To use the instrument, all that is necessary is to lower the bottom gently and relieve the coil. The mirror is so arranged that the axis of rotation lies in the centre of the reflecting plane and the mirrow window of the cage is tilted to prevent reflection from its surface.

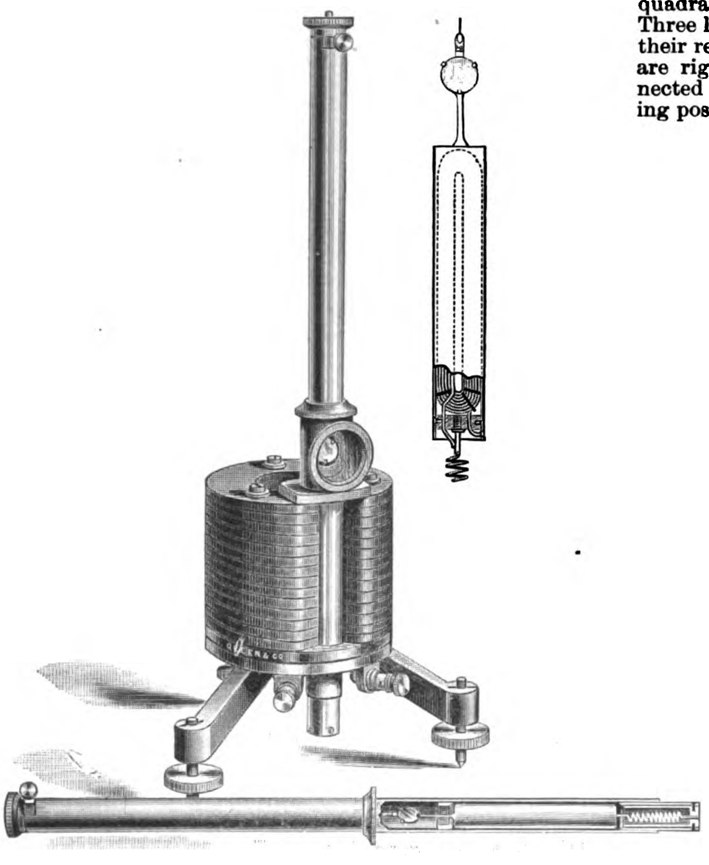


Fig. 1.—New Queen D'Arsonval Galvanometer.

The instrument is sensitive to a high degree, and being absolutely uninfluenced by strong and varying fields, or mechanical vibrations, gives accurate results when used in a dynamo-room as when used on a brick pier in a laboratory. It therefore extends the range of usefulness of a highly sensitive galvanometer far beyond anything yet reached. For general use the motion is made absolutely dead beat, so to obviate the necessity of using "tapper keys" and to save an enormous amount of time, which is very important when rapid and exact work is demanded. This should recommend it to central station men, as well as to professors. Tubes are also made for ballistic work in which the damping effect is lessened, and in this connection a bifilar suspension has been used.

With two suspensions of .0015 inch thick phosphor-bronze strip 20 inches long and $\frac{3}{32}$-inch apart and a coil of 703 turns of No. 40 copper wire whose resistance is 450 ohms, a throw of 25½ cms. with one microfarad and one Carhart cell and a period of 10 seconds was obtained. When used as a ballistic galvanometer, the coil on being thrown to the end of the scale may in every case be brought completely to rest in from 12 to 15 seconds by merely short-circuiting. The instrument can also be used for thermal work and with a suspension of phosphor-bronze strip rolled from .002-inch round wire, spring .00004 volts per degree C. change, a deflection of 1.9 cms. per degree change was obtained. It is certainly a very remarkable instrument, being second in sensibility only to a high grade Thomson galvanometer, and second to none in being uninfluenced by varying external fields or mechanical vibrations.

Fig. 2 represents the Ryan electrometer. This instrument was designed by Professor Harris J. Ryan, of Cornell University. for measuring potential difference, either direct or alternating. The quadrants, four in number, are mounted on two quartz discs, set on the inside of two metal cover plates that protect the system, and are faced with mica to prevent short-circuiting should the needle happen to touch them. The needle is cylindrical in shape and can be hung with either quartz or silk suspension. It is situated exactly in the centre of the cover case, and just above it is fastened the mirror whose silvered surface contains the axis of rotation. The cover case is made of two parts symmetrically disposed with respect to the system, and held in position by a spring clip. In this way both parts, each carrying a pair of quadrants, can be lifted from the frame so that it can be inspected. Three little pegs over which half of the cover plate fits, insure their returning to the same relative position. Opposite quadrants are rigidly connected by metal strips, the two pairs being connected to binding posts on the outside of the cover case. A binding post also on the outside of the cover case connects with a hook on the inside, from which a connection is made with the needle by a platinum wire .0002-inch in diameter.

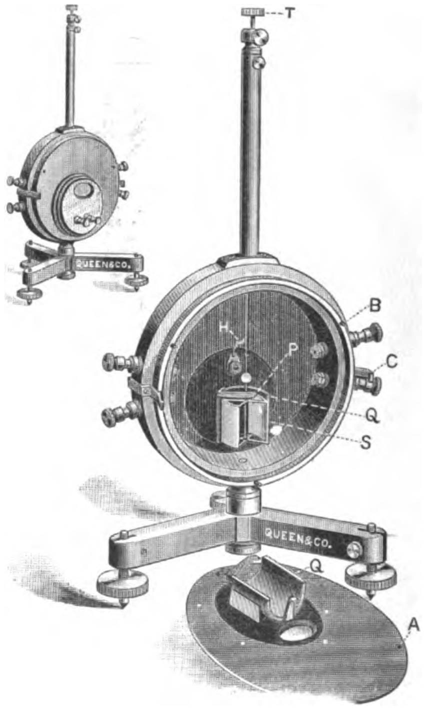
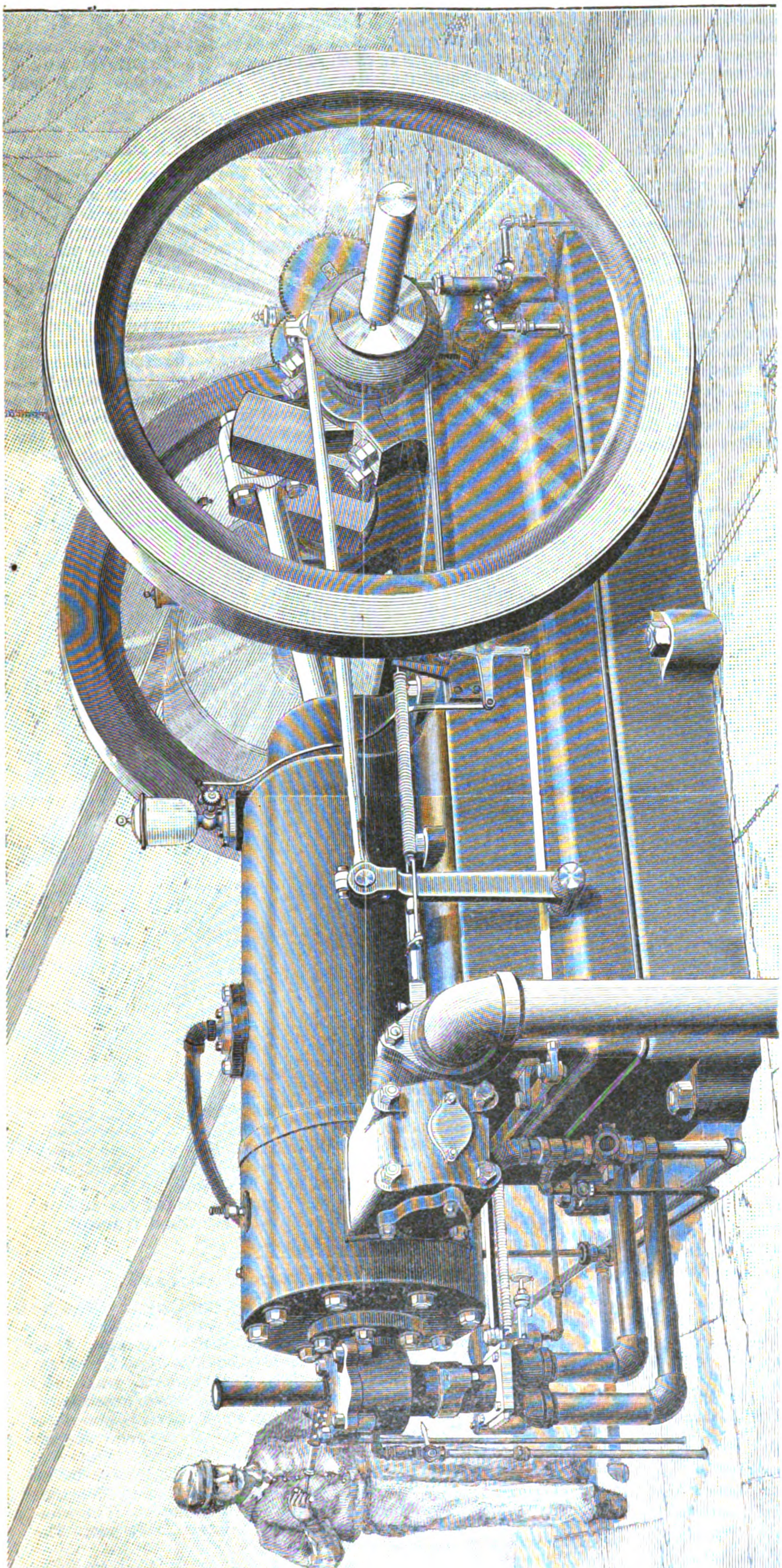


Fig. 2.—The Ryan Electrometer.

On the circumference of the cover case, and symmetrically disposed with respect to the system, are two wound coils, one of coarse and the other of fine wire. These enable the instrument to be used in both ways; either the E. M. F. may be calculated from the deflection it produces, this being measured by a scale and telescope, or else a zero method may be used, in which the needle is brought back to zero, after being deflected by the action of a current passed through the wound coils mentioned above, and the E. M. F. calculated from the magnitude of this current. This latter has the advantage of giving results unaffected by changes in the earth's field. The instrument can be used with equal success on direct and alternating circuits, as it takes no current and has no induction to be corrected for. It takes up very little room, is strong in construction and recommends itself as much for commercial as for laboratory work. It is especially advantageous in determining the efficiency of transformers by the "three electrometer reading" method.

The above instrument together with various other new forms of standard measuring apparatus, are described in a handsome supplement to catalogue I—66, recently issued by Queen & Co., Incorporated, who will be pleased to forward a copy to interested parties.



The Caldwell Gas Engine for Electric Lighting.

THE CALDWELL GAS ENGINE FOR ELECTRIC LIGHTING.

It has been completely demonstrated that by the employment of gas to drive a gas engine and dynamo more light in candle power can be obtained than if the same amount of gas is burned in the regular gas light burner. If to this we add the fact that a gas engine requires no fireman and leaves no ashes, is smokeless and cleanly in the highest degree, it is evident that it fills a place in electric lighting which, though even now appreciated, must in the future make it a prominent factor not only in isolated plants but in central stations as well. Indeed, not a few gas companies operating electric lights, both here and abroad, have recognized the advantages of the gas engine and employ it with marked economy.

Perhaps one of the reasons for the slow introduction of the gas engine for this class of work is due to the fact that until recently these engines were built in sizes reaching barely above 30 h. p. and hence necessitating a number of engines where any considerable number of lights was demanded. Happily this condition of affairs now no longer exists as we are able to illustrate in the accompanying engraving a gas engine of no less than 100 horse power.

One of these engines, which are built by Messrs. H. W. Caldwell & Son Company, of Chicago, Ill., is now in use at the the large grain elevator of Taylor Brothers, at Cooper's Point, Camden, N. J. The engine is operated by carbureted air, consisting of a mixture of common air and gasoline vapor. This provides a fuel which is not only invariable in quality, but is quite inexpensive. In large quantities the gasoline costs six cents per gallon in large cities, and as this engine is operated by one gallon of 74° gravity gasoline per horse power for ten hours, it will be seen that the cost of fuel is very light compared with the power yielded.

The cylinder has a bore of 16½ inches and the stroke is 24 inches. The crank shaft has a speed of 150 revolutions per minute. The gasoline is drawn directly from a tank considerably lower than the the engine, and its vapor is mingled with the air without any special carbureting device. The governor limits the number of charges admitted to the cylinder by controlling an air gate over one of a pair of air tubes shown at the rear of the engine. The air gate has two ports and allows air to be drawn through either tube according to the action of the governor. In one tube there is a nozzle leading upward from a reservoir containing less than a pint of gasoline, and when the port above this tube is opened the engine takes in an explosive charge. The charges are ignited by an incandescent tube incased in a larger tube lined with asbestos.

Heretofore, one objection to large gas engines has been the use of tube timers; in this engine they are entirely dispensed with. Another objection to large gas engines has been the difficulty in starting; in some cases, small auxiliary engines have been used for this purpose. All this is obviated in the Caldwell engine by the use of a novel self-starter, which consists of a hand pump used for forcing the charge into the cylinder and a detonator for exploding the charge after it has been introduced. This device gives the engine its first impulse, after which it continues to operate steadily with its automatic gear.

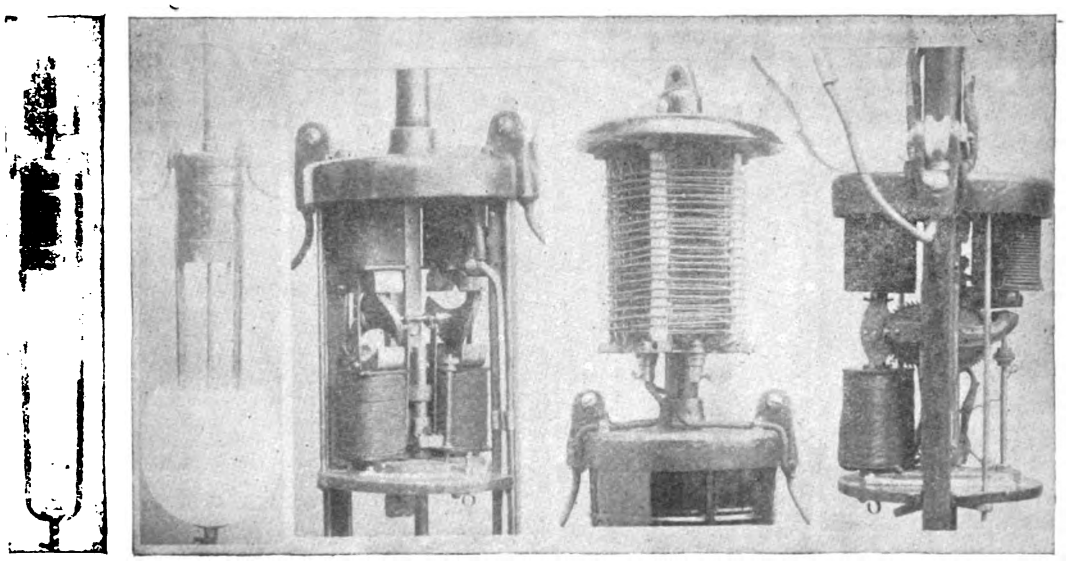
The engine, which is the invention of Mr. James A. Charter, well known in the gas engine business, has been thoroughly worked out mechanically and is built in the best possible manner.

THE NEW MOSHER ARC LAMPS FOR DIRECT AND ALTERNATING CIRCUITS.

THE new Mosher arc lamps for direct and alternating circuits, are the result of four years of experiment and practical tests, and as now constructed possess many novel and economical features. In their construction there is used both clutch and clock feed, the former for multiple arc, and the latter for series work, which feeding mechanism commends itself for its simplicity. The lamp is provided with switches, cut-outs, etc., so that when the carbon is burned out the lamp will be automatically cut out of the circuit.

The accompanying engraving Fig. 1 shows the lamp with the case on complete, with rheostat mounted on the frame, the latter feature being patented by the company. The lamp is furnished with either clutch or clock feed, to burn singly on from 50 to 125 volts for inside use. When it is used for external, or outdoor work, it is furnished with a wire-support. It requires no hood, but a hood is furnished when desired.

Fig. 5 shows the internal mechanism of the lamp, Style C 12. This lamp in its outward appearance, with the case on, is similar to the former, but is provided with a compound rheostat and cut-out. This compound rheostat, Fig. 4, is mounted on the lamp; one winding is a very low resistance, and is in circuit all the time, and the other is equal to the resistance of the arc of the lamp when burning, and is automatically cut-in circuit when for any reason the arc is broken. This insures the perfect working of the other lamps should one or more in the same series refuse to work from any cause.



FIGS. 1 TO 5.—MOSHER ALTERNATING AND DIRECT CURRENT ARC LAMP.

Fig. 2 represents the new Mosher alternating lamp, Style F 13, complete, ready for putting in circuit. No extra resistance is required with this lamp, which is wound for from 50 to 55 volts.

The engraving, Fig. 3, shows the internal mechanism. It will be noticed that the carbon is controled by rotary motion. All connections are made in such a way that it is impossible for them to get loose and rattle. In the construction of these lamps all wearing parts are so constructed, that the natural wear is taken up automatically; therefore, they can never rattle, or "sing," a feature so objectionable in all alternating arc lamps previously manufactured.

The railway circuit arc lamp, known as Style R 15, is constructed mainly for use on railway circuits, and can be made to run from 5 to 10 in the series on a 500 volt circuit. These lamps are constructed with a rack feed, and are wound to vary from 6 to 10 amperes, according to the light desired. The arc forming mechanism is operated by an armature which separates the arc the desired distance to start with, and after that does not vary. The feeding mechanism is controlled by separate magnets, one in shunt, and one in the main circuit, which releases the escapement and allows the lamp to feed only when the arc has passed beyond, or attempts to use more, than its proportionate share of the voltage of the system on which the lamp is run. The main circuit magnet is wound in such a relation to the derived circuit, that when the lamp is regulated for certain amperage, it will be impossible for the amperage to vary very much from the amount for which the lamp is regulated. That is, if the lamp is regulated for seven amperes, and the voltage of the system should decrease, the same amperes would be practically maintained, thus preventing the arc being broken by reason of insufficient pressure. If the voltage should increase, the lamp would not feed until the current had reached the normal, or seven amperes; so that it is almost impossible to burn a lamp out. This regulating magnet can be made as sensitive as it is possible to be made, as vibrating or pumping of the magnet will not interfere with the arc, and it is therefore unnecessary to use a dash-pot. This will be appreciated by lamp users.

TO STUDY INSULATION AND INSURANCE ABROAD.

MR. WILLIAM MCDEVITT, Chief of the Electrical Department of the Philadelphia Fire Underwriters Association, sailed for Europe on the North German-Lloyd Steamship *Lahn* on Feb. 21st, 1893. Many claims have been made by authorities in foreign countries of superior methods in the distribution and use of the electric light, especially as to "wiring" and its application to houses and for safety from fire. This subject Mr. McDevitt will particularly inquire into, and he will also examine the safeguards used for the protection of theatres. Philadelphia has the largest number of electric lighting stations of any city in the United States. This class of risk has almost been refused insurance throughout the country owing to the number which have been burned down—yet Philadelphia has never even had a serious fire in a single station. Mr. McDevitt will visit Berlin, London, Paris, Vienna and Marseilles, and goes at the request of nearly all the electrical contractors, central stations and electrical engineers in the city of Philadelphia who are interested in this work, and who believe that our methods are not very far behind.

The Philadelphia Fire Underwriters Association has granted Mr. McDevitt a two months leave of absence, and he carries with him letters from Hon. Edwin S. Stuart, Mayor of the city of Philadelphia, to the municipal authorities abroad, besides other letters which will give him the entree to all places he may wish to visit. A very full and interesting report is looked for and one which cannot fail to be of great use to the electrical fraternity in general.

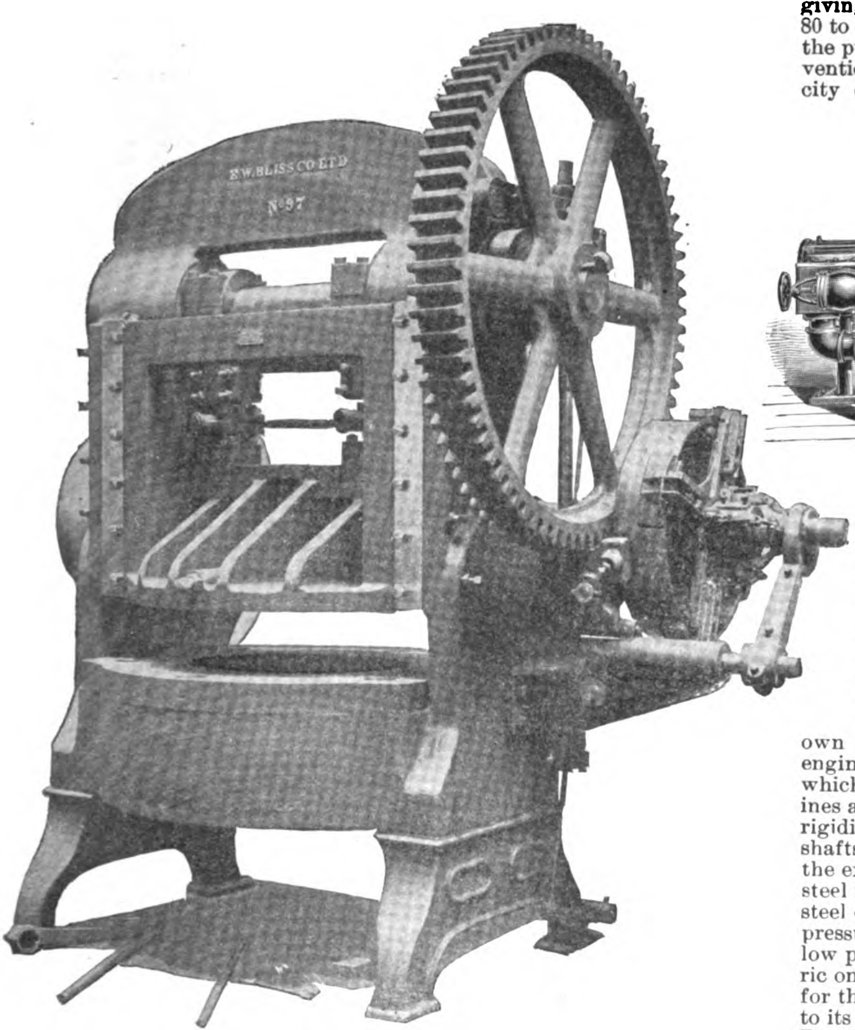
CROCKER-WHEELER ELECTRIC COMPANY.

AN important step has been taken by the Crocker-Wheeler Electric Company in the purchase of the entire property and plant of the Spiral Weld Tube Company, at East Orange, N. J., whither they will move about the middle of March, establishing offices down-town for the convenience of their city trade and out-of-town visitors. They are now purchasing heavy machinery, cranes, etc., for the shops, and putting in Western Union telegraph and Long-Distance telephone wires. A railroad station will be built for them at the factory. It will be called "Ampere," and all trains will stop there. In the factory there will be no lines of shafting, but the tools, etc., will be driven by Crocker-Wheeler motors, taking current from a central plant. The company now has a capital stock of $350,000, selling above par. The demand for its motors is enormous.

F. P. LITTLE of F. P. Little & Co., Buffalo, was a World's Fair visitor last week and was a caller at the ENGINEER'S Western office.

THE BLISS CUTTING PRESS.

The accompanying illustration shows a press for cutting out large armature discs recently built by the E. W. Bliss Company of Brooklyn, for the General Electric Company of Schenectady, N. Y. The construction of this press embodies a number of special features which have not heretofore been used in connection with presses of this class. In order to give a firm support and accurate guidance to the large and delicate dies, the ordinary centre gib has been abandoned and the ways of the slide are spread apart so as to be as wide as the frame itself. This has also made it possible to lengthen the ways considerably without increasing the height of the frame. The additional solidity and accuracy due to this mode of construction is plainly seen. Another special feature is the application of a new automatic friction clutch which obviates entirely many of the difficulties experienced with the regular automatic clutches on heavy back geared presses. Its application and construction will be readily understood. A pressure on the foot treadle shown, releases the weight which actuates a powerful friction clutch on the back shaft, thus starting the press almost instantaneously and obviating entirely the heavy metallic blow, which in the ordinary clutches tends to destroy the parts and frequently causes expensive delays and repairs. After the shaft has made one complete revolution a cam releases the friction clutch, bringing into action at the same time a brake and thus stopping the slide at the highest point of its stroke. The large gear wheel instead of revolving continually, is, with these new clutches, keyed on the shaft, and at a standstill until the clutch is thrown into action. This constitutes an additional advantage in the saving of considerable wear on the shaft and wheel hub.



The Bliss Cutting Press.

There is nothing about these clutches which is liable to get out of order, and for whatever wear may be occasioned by continuous use easy means of compensation are provided. This press will cut armature discs 30 inches or more in diameter. It has a distance between the housings of 51 inches and is generally made with a 30-inch round opening in the bed, which, however, can be varied to suit special requirements. It is geared 1:10 and has a fly wheel weighing 1800 pounds on the back shaft. The weight is 30,000 pounds.

The E. W. Bliss Co., also make a large variety of smaller presses of this class, many of which are now in use in nearly all the large electrical works.

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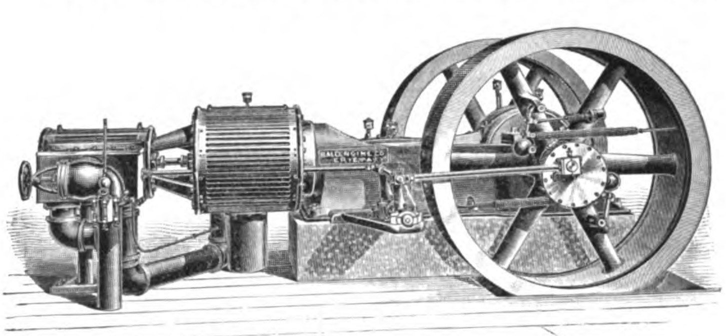
400 H. P. TANDEM COMPOUND BALL ENGINE.

This engine is an outgrowth of the experience of The Ball Engine Co., of Erie, Pa., in the manufacture of engines of smaller capacity, adapted to the work of driving street railway generators; the demand from this service for economical motive power within small space and safety of operation being such that this type of engine is now found to be a winning competitor with single cylinder Corliss engines of 28 inches x 48 inches to 26 inches x 60 inches cylinder capacity and wheel diameter of 20 feet. In this engine the stroke is made short for the purpose of raising the number of revolutions and reducing the wheel diameters so as to more nearly approach the diameters of the generator pulleys, giving better belt contact. The range of wheel diameters is from 80 to 112 inches, which enables the engine to drive directly on to the pulleys of the different makes of generators without the intervention of line shafts or other divices for raising the lineal velocity of the belts, this being accomplished within economical ranges of piston speed, *i. e.*, 600 to 700 feet per minute, and perfectly reasonable as well as economical steam preasure, *i. e.*, 100 to 115 lbs.



400 H. P. Tandem Compound Ball Engine.

The engine herewith illustrated is one of several which have been put in operation within the past year. It is perfectly balanced and does not require the enormous foundation which its slow speed competitor is obliged to have, one of them giving the most satisfactory results at a speed of 210 revolutions on a pier of its own length, 17 feet high, piercing a comparatively light engine room floor, 14 feet pitch from the basement floor, on which is located all of the steam plant outfit other than the engines and dynamos. The engine is endowed with great strength, rigidity and long living powers, owing to the form of the frame, shafts, cylinders, heads, and reciprocating parts; the latter, with the exception of the pistons and wrist-pin boxes, being of forged steel from tip to tip. The shaft is of one solid piece of forged steel of a grade that is most excellent for the purpose. The high pressure valve motion is derived from the governor, while the low pressure valve is driven by direct connection from an eccentric on the other side of the engine, this eccentric being adjustable for the purpose of making a more perfect adaptation of the engine to its load when the actual running conditions are demonstrated. The valves of the "nearly" balanced type, are absolutely steam tight, and will remain so, indefinitely, as the wear is so trifling that a few hours of scraping, it is said, will renew the faces and make them as good as when first started, after two or three years run of 10 to 18 hours per day. The general features of the engine are suggestive of correct location and distribution of the parts and materials involved. If one will consider the facts existing in a compound engine, it will be found that in the underloaded state, the high pressure cylinder does the most work, the total of which does not represent a destructive strain on any of the parts, but as the load increases and gets beyond the medium line where the work is equal, the force bearing on the low pressure piston becomes greater and that on the high pressure piston less; hence, the position of the low pressure piston on the rod is of the greatest importance, and, in conscientious construction, demands that the low pressure cylinder shall be next to the frame for the purpose of better fastening and the superior opportunity carrying the large piston, which for security of fastening, must have the larger end of the rod.

The engine shown in the accompanying illustration has 28 inches high pressure and 30 inches low pressure, cylinders, with 18 inches stroke pistons, carries two wheels of 96 inches diameter by 25 inches face, weighing 10,000 lbs. each, giving a fly wheel capacity and efficiency equivalent to more than double their weight if made into a 20 foot wheel for a 60 inch stroke engine, making under ⅓ as many revolutions. It is being demonstrated in this plant that with a regulation giving an increase of speed of one per cent. from empty generators to full capacity, *i.e.*, 350 k.w., that the voltage taken at 480 when no current is being used, will follow the increase of engine speed almost exactly up to the maximum of 500 for full load.

ANGIER AND KENNARD.

THE above names have become in the last few months almost a household word in Chicago electrical circles, representing as they do several of the best rubber factories of the east. They have enjoyed a most flattering reception by the trade in the west. Mr. Angier and his partner Mr. Kennard are both young men who are well and favorably known to the trade and are nearly always "in it" when anything in rubber goods is wanted. The firm is established under most flattering circumstances, with ample capital, wide acquaintance and a thorough knowledge of the business engaged in. They are very desirably located on the fifth floor of the Monadnock office building.

NEW KESTER ATWOOD ARC LAMP.

THE A. H. ATWOOD ELECTRIC & MANUFACTURING COMPANY are just putting on the market a most desirable arc lamp, made for use in connection with every known system of electric lighting. The mechanism of the lamp is simplicity itself. It is not exactly an ornamental lamp in a general sense, but is very handsomely made and suggests many features which make it desirable for lighting stores, etc. These lamps may be operated on any incandescent circuit in connection with lamps of from 50 to 100 volts. The lamp will be shown at the convention by Mr. J. F. Kester, and should be seen by all interested.

WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY report that business is already beginning to open up on the Meston alternating current fan motor, and that they have already closed a number of agency arrangements and entered some very large orders for fan motors. The Meston motor is so well known that applications come in from every part of the country, and the Electric Appliance Company plan to have a good live agency thoroughly established in every large town having an alternating plant before the fan season opens up. This agency is a valuable one and the applications are numerous.

INTERIOR CONDUIT has been very active during the past week, several of the larger buildings in Chicago being equipped with this well-known system. Mr. Romaine Mace, the representative of the company is in the city and makes his headquarters with the General Western agents, the Central Electric Company, giving them the benefit of his experience and untiring energy, in taking care of the present heavy business and laying plans for more enlarged development.

CAPTAIN JOHN A. GRIER, whose face has long been known in western electrical circles, has recently become associated with The Ansonia Electric Company, (formerly the Electrical Supply Company) and is at present at the Helios factory in Philadelphia, where he is familiarizing himself in every detail with the Helios Arc Lamp for alternating circuits, with a view of introducing it to the western trade.

OKONITE WIRE has been specified for the Congress Hotel, the new annex to the Auditorium. Okonite wire was selected purely upon its merits as an insulator over all other competitors, the Auditorium having had a varied experience with other wires, and a practical demonstration of the superior merits of the lasting qualities of Okonite.

THE RIEHLE BROS. TESTING MACHINE COMPANY announce that, beginning April 1, Mr. J. R. Matlack, Jr., will act as its representative at the World's Columbian Exposition, Chicago, and can be found, previous to the opening of the Exposition, at the office of R. W. Hunt & Co., The Rookery, Chicago.

MR. J. E. ZEUBLIN, acting general superintendent, has been appointed general superintendent of the Chicago Telephone Co. His office will be at Room 21, Telephone Building, 203 Washington street, Chicago.

MR. C. E. BROWN of the Central Electric Company has just returned from a very successful trip, both in the way of orders and expressions of good will from the Central's customers, whom he visited.

A. M. MORSE, better known as the "Buckeye Engine" man, called at this office on Saturday last. Mr. Morse is located in the Commercial Building, St. Louis. He reports the engine business good.

NEW YORK NOTES.

THE AUBURN ELECTRIC MOTOR COMPANY has been incorporated with a capital stock of $50,000, and the following officers chosen: Chas. H. Lucas, president; J. P. Hutchinson, secretary and treasurer. Directors: Chas. H. Lucas, Walter F. Brown, Henry J. Davis and J. P. Hutchinson. Chas. H. Lucas is also superintendent of the mechanical department and Walter F. Brown is electrician and superintendent of the electrical department. A general electric business will be done. The company has already bought a large building for a factory, with sufficient land for future enlargement, if required.

DIEHL & COMPANY, at No. 385 Broadway, are entering the field for the coming season fully equipped with an extensive stock of their electric floor column, propeller, and their specialty, the "Diehl" ceiling fans. Each fan contains its own motor, thereby obviating the necessity of shafting and belting. This, in connection with its thorough reliability and the fact that it is highly ornamental and is installed without disfigurement of the finest apartment, accounts for the enviable position it holds in the trade to-day.

CARPENTER RHEOSTATS. The new catalogue of the Carpenter Enamel Rheostat Co., of Bridgeport, Conn., is an exceedingly well printed pamphlet, setting forth in clear and concise manner the merits of this ingenious apparatus. Mr. Chas. D. Shain, of 136 Liberty Street, the general selling agent of the company, is to be congratulated on the way in which the rheostats have taken hold of the electrical public.

THE NATIONAL INDIA RUBBER COMPANY, of Bristol, R. I., makers of "N. I. R." insulated wires and cables have opened a branch-office at 487 Broadway, New York City, with Mr. H. L. Burdick as manager. Their wires have been approved by the Fire Underwriters Association, of New York, Boston and Chicago, and orders for large quantities are constantly reported from all parts of the country.

MESSRS. J. JONES & SON, of 39 Vesey Street, this city, have issued a very compact catalogue of forty pages descriptive of their annunciators, call bells, batteries, burglar alarms and other electric appliances. This firm also make a specialty of gas lighting apparatus, which they manufacture in great variety.

THE E. G. BERNARD COMPANY, Troy, N. Y., will remove May 1 to larger and more convenient quarters, at No. 43 Fourth Street, where they will have a much larger store and office. The growth of their business renders these increased facilities highly necessary.

W. S. CHESLEY & CO., of 24 Morris street, Jersey City, N. J., desire to hear from brass and copper companies in regard to lamp parts, commutators, segments and everything used in repairing apparatus.

MR. A. E. SCOULLAR, general superintendent of the New York Brush Illuminating Company, for many years, has resigned his position to engage in business outside electricity. His old associates have presented him with a very handsome testimonial.

ST. LOUIS NOTES.

THE ELECTRIC SELECTOR AND SIGNAL COMPANY will have an exhibit at the St. Louis Convention that should be peculiarly interesting to all electric light men. This exhibit will consist of the Company's system of selective arc light and motor cut-outs. Some new devices have lately been added to the system which materially simplify the operation of the cut-outs; these will be shown for the first time to the electrical profession at the Convention.

The Company will be represented at St. Louis by Messrs. C. P. MacKie, Robb MacKie, S. S. Bogart and Herbert Laws Webb.

THE SOUTHERN ELECTRICAL SUPPLY COMPANY of St. Louis report very brisk sales of Interior Conduit and Okonite wire in their territory. The following buildings are the latest to be equipped with the Interior Conduit system throughout: Rialto Building, Mercantile Club, St. Nicholas Hotel, Security Building, Planters Hotel, Union Trust Building, Polytechnical School Building.

THE ELECTRIC APPLIANCE COMPANY takes pleasure in informing their friends and announcing to the trade generally, that they have taken the Western Agency for the celebrated "O. K." weatherproof house, line and feeder wires, and will carry a large and complete stock in Chicago. The quality of the "O. K." products are too well known to call for any extended comment.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

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CARBORUNDUM:—ITS MANUFACTURE AND USE.

BY

E. G. Acheson.

SHOULD the reader ever have paused to give the subject a thought, he must have been struck by the wonderfully simple process employed by nature in the construction of her waterways, the leveling of the high and the filling of the low places, the cutting down of the great rocks, and the polishing and beautifying of the small pebbles of the beach. Has it ever occurred to him that man has appropriated this same agency for the building up of what we call civilization? If so, he must, now realize the immense value of this process, and if not, he must, at a simple suggestion, admit the all-important part in the work of nature and man, of *abrasion*. Not a tool, nor an article made by means of a tool, would we possess did we not employ abrasion during some part of its manufacture. It is the most universally employed of all processes. The act of abraiding being so all-important, of what immense value to man, then, must the best abrasive material be!

A complete list of natural abrasives would, probably, include all of the known rocks and earths. Many of them are, however, of little value, and for industrial uses, not more than ten or twelve are made used of. These are selected on account of their efficiency or their liberal supply and consequent cheapness. Those we find most ordinarily used are, diamond or crystalline carbon, sapphire, ruby, corundum, emery, rotton stone, and rouge. Since the beginning of time man has known of nothing superior, or equal, to the diamond as an agent of abrasion, and it is now used in a crushed or powdered form for the abrasion of hard substances, when the value of the completed articles justifies the use of an agent so costly.

The above abrasives are used in the order named, as the work is more or less hard to perform, or as its degree of perfection requires, restricted by the cost of the abraident and labor. Thus, the costly diamond and sapphire are, in the machine-shops, factories and mills, replaced by the cheap corundum and emery, as the cost of the former would more than balance the increased labor and time required with the latter. It is therefore easy to realize how great a boon to the manufacturing industries would be a material having the extreme hardness of the diamond and the cost of corundum; such a substitute we find in "carborundum," its very name encompassing those two important abrasives.

Carborundum (from carbon and corundum) is a new material, both to chemistry and the mechanical industries. It is a purely manufactured article and marks another triumph for electricity in the domain of chemical industries—another illustration of this invisible agent, guided by man's hand, tearing apart the closely united elements joined by nature, and re-arranging them for his industrial uses. It is composed of carbon and silicon in the proportion of one atom of each to a molecule, the chemical formula being SiC.

The process by which carborundum is produced, is one of more than ordinary simplicity. It consists of the introduction of an intimate mixture of carbon and sand into an oblong box of bricks or clay, into each end of which project one or more rods, or electrodes, of carbon, and through these rods of carbon and the mixture of carbon and sand, passing a current of electricity of a sufficient quantity, and for the proper length of time, to fuse the mass and cause the reduction of the contained silicon and its subsequent combination with a portion of the carbon.

The accompaning illustration, Fig. 1, shows one of the earlier forms of carborundum furnace, with the attendant furnaceman and instruments for regulating the electric current.

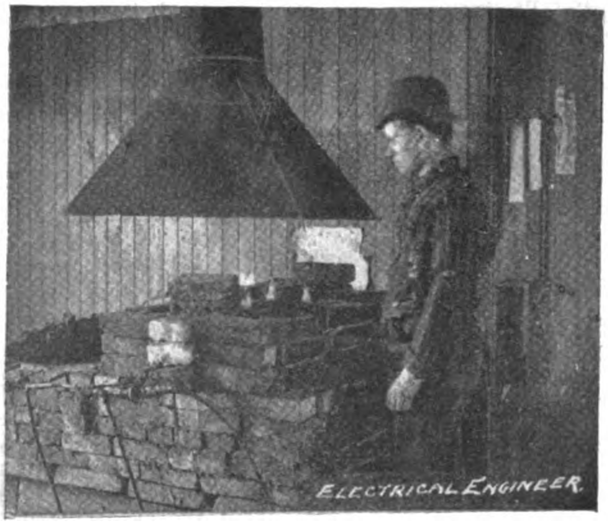


FIG. 1.—EARLY FORM OF CARBORUNDUM FURNACE.

The crude simplicity of the furance is probably its most striking feature. The company have now under construction, three furnaces having a united daily capacity of five hundred pounds.

Upon removal from the furnace the carborundum is in the form of a porous cinder-like mass, consisting of crystals of various sizes. This mass is first washed in water, then treated with acid to remove soluble impurities, again washed, then dried and crushed. The crushing breaks apart the individual crystals and these are then separated into the commercial sizes or degrees of fineness. This separation is now done by the ordinary sifting process; that method will, however, soon be replaced by a more perfect arrangement, consisting of a series of tanks through which flows a continuous stream of water, the sizes of the tanks increasing in the direction in which the water flows, and the sizes of the crystals deposited being in the reverse order, that is, the larger in the first or smaller tank and the smaller crystals in the last or larger tank.

The first commercial use to which carborundum was put was the cutting and polishing of diamonds, a class of work never before accomplished by any abrasive other than the natural crystalline carbon or diamond. Tradition, supported by the state of the art, required a diamond to cut a diamond, and "Diamond cut diamond" arose as a mighty Sphinx in the pathway of carborundum in the diamond-cutting industry. The diamond cutters, with the exception of a very few, would not admit the possibility of manufacturing a material that would cut diamond, and asserted that carborundum was not sufficiently hard to perform the work required. The writer, however, has stood for hours, and at various times, by a diamond cutter's lap and watched the cutting and polishing of diamonds by means of carborundum.

Notwithstanding these difficulties, some small quantity was sold for diamond and lapidary work both in this country and Europe, an agent having gone over to Holland for the purpose of introducing it into the Amsterdam diamond-cutting works. In the meantime improvements were made in the process of manufacture, and a greatly increased output was obtained. In June, 1891, a stock company, under the title of the Carborundum Company, was organized for its manufacture, the price greatly reduced and the attention of brass manufacturers and metal workers called to its superiority over emery in grinding valves, etc. The amount of business developed in the diamond industries was so small that the company ceased to push it and devoted its attention to the other industries. In June, 1892, still further improvements were made, resulting in increasing the production to 25 pounds per day, and the company again lowered the price to $2.00 and $4.00 per pound, depending on the quantity purchased.

During these months many experiments were made in the manufacture of wheels, hones, and other articles or forms in which abrasives were used. These experiments terminated in, or led to, the construction of a kiln as used in the more improved processes of pottery manufacture. The kiln was first fired on Sept. 20, 1892, and it is with much personal pleasure the writer states that from the date of that firing the business of the company has been phenomenal. The company are now adding an extensive addition to their plant and expect in thirty days to be manufacturing five hundred pounds of carborundum per day.

The Carborundum Company at present occupies a portion of the premises of the Monongahela (Pa.) Electric Light Company and from them it obtains the electric current used in the formation of carborundum. The present plant of the light company is 75 h. p., and with the additions now under construction they will have a total capacity of 300 h. p. It is probable that the Carborundum Company will, during this year, start the construction of an extensive plant for their own use.

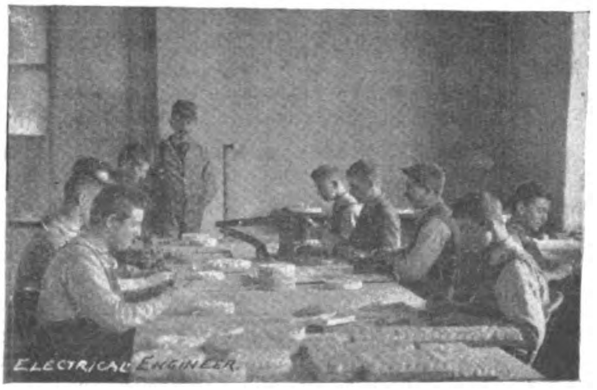

ELECTRICAL ENGINEER.

FIG. 2.—MOLDING SMALL CARBORUNDUM WHEELS.

The completion of the kiln produced a decided change in the business of the company. It was quickly found that a wheel of carborundum properly constructed was a very superior tool for the cutting of glass, porcelain, steel, and similar hard substances. Extensive and prolonged experiments were made for determining the best material for binding together the carborundum, and as a result a series of bonds have been adopted, each having peculiar advantages for some specific kind of work. It was also found that the percentage of bonding material used in the wheels should be varied for the different kinds of work to be done.

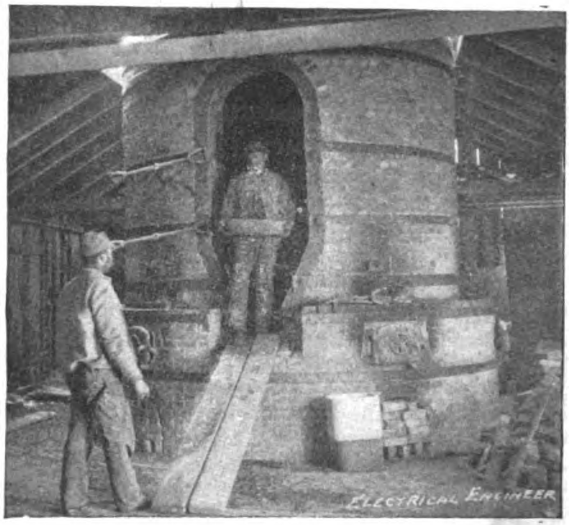


FIG. 3.—REMOVING "SAGGERS" FROM THE KILN.

The Westinghouse Electric and Manufacturing Company, of Pittsburgh, Pa., are using carborundum in wheels and grains for the grinding-in of the stoppers of their new lamp, their present consumption amounting to several thousand wheels per month.

In the early part of January of this year, carborundum in small wheels, discs and points, was introduced into dentistry, as a substitute for the emery heretofore used. It was received in a very flattering manner, amounting to almost enthusiasm, on the part of dentists, many of them stating that the wheels were equal, in rapidity of cutting, to the diamond discs used by them.

For wheels, hones and other manufactured articles requiring a hard binding material, the carborundum, in the appropriate degree of fineness for the desired article, is placed in the hands of a workman who mixes it with a predetermined percentage of binding materials, after which it is ready for molding or pressing into the required forms. Our engraving, Fig. 2, illustrates the molding of the dental wheels, discs and points and the small wheels used for the Westinghouse lamps. As these wheels are made, they are placed on little blocks of burnt clay, called "bats," the upper surface of the "bat" being a counterpart of the wheel it supports. The little "bats," with the wheels they support, are themselves placed upon larger "bats" and the whole set in clay boxes called "saggers," and these are carried into the kiln and there piled in columns. When a sufficient number of these are placed in the kiln, the door of the latter is built up with bricks and the fires lighted. The heat is increased slowly, through a period of about 30 hours, careful watch being kept for the fusing point of the bonding material. This fusing point is determined by means of little test pieces, which are withdrawn from the kiln, at frequent intervals, through small holes or windows, made in the sides of the kiln for that purpose. When the bond starts to melt, the temperature is held constant for some hours, and then permitted to fall, the whole operation requiring from 60 to 80 hours. The kiln having cooled sufficiently, the door is opened and the "saggers" containing the finished product are removed. The removal of the saggers is shown in the illustration, Fig. 3.

In the manufacture of wheels for machine work, the materials are taken from the mixer to a workman who weighs out the required amount for the wheel desired; this is placed in a steel mold and together they are introduced into a hydraulic press, where the desired pressure is applied —this pressure varying from one to 100 tons, depending upon the size of the wheel being made. This operation of filling a mold and introducing it into a 100-ton press is shown in Fig. 4. When the mold is removed from the press, it is opened and the formed wheel placed upon a "bat" and then in a "sagger" and treated as in the case of the small wheels.

It was probably to be expected that a material composed of the elements entering into carborundum, would have many interesting and useful applications. That this is the case, has even now been demonstrated. It would be difficult to think of a more novel use for it than its introduction into the electric lamp, as the light-giving body. [Carborundum formed into buttons and mounted in lamp bulbs was exhibited by Mr. Nikola Tesla before the Institution of Electrical Engineers in London in February, 1892. While the future use of carborundum for this purpose is, as yet, problematical, Mr. Tesla has already accomplished very much towards the perfecting of his system of lighting, embodying within its details the use of lamps, depending upon this remarkable material for the transmutation of electric waves into light waves. The chemist also will find in carborundum a new reagent, which the future may prove to be of unusual value.

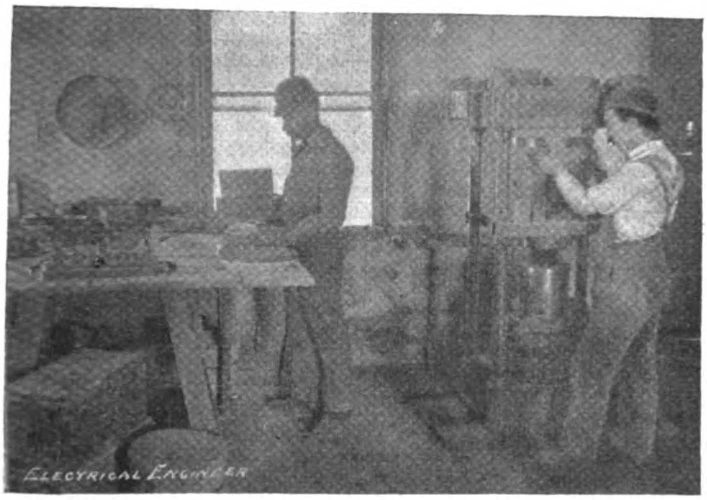


FIG. 4.—FILLING AND PRESSING THE MOLDS.

The Carborundum Company are now arranging an attractive exhibit of their crude and manufactured materials, for the World's Columbian Exhibition, having been allotted 250 square feet of space in the Mines and Mining Building.

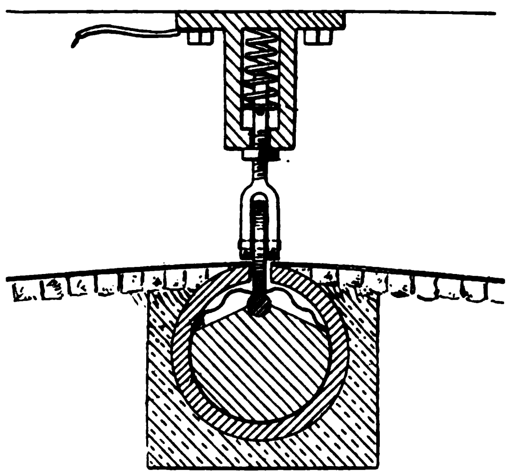
WORLD'S FAIR BRIEFS.

MR. Frederick Sargent, mechanical and electrical engineer of the Columbian Exposition, has been promoted to a position in which he will have several assistants to perform under him the work of the department. The work has been divided into two sections. The mechanical engineering section will be in charge of Mr. Richard Pierce. Mr. Sargent will remain at the head of the two divisions and direct the work of both.

The World's Fair grounds and buildings have a combined water capacity of 54,000,000 gallons a day, and will soon have 100,000,000. There are 25 miles of water mains and 291 hydrants, and a hundred more will be provided. There are three steam fire engines, four chemical engines, a ladder truck, water tower, 40 hose carts, 26,750 feet of hose, 1,050 hand fire extinguishers, 2,500 fire pails, a steam fire boat, 65 firemen, 150 alarm boxes, 150 patrol telephones, 500 guards and complete electric light and sewerage systems.

THE PERKINS ELASTIC RAILWAY CONDUIT.

AMONG the many and various conduits for electric street railways, that recently designed by Mr. F. C. Perkins, of Buffalo, N. Y., possesses the merit of simplicity and cheapness of construction. The accompanying illustration clearly shows the principle involved. The bare conductor is mounted on a stringer of wood impregnated with oil, or some other insulating substance, and entirely surrounded by a flexible metallic tube. The current collector carried by the car presses this tube downward, making contact with the conductor and completing the circuit. The conductor is thus absolutely protected from water, mud, etc., and perfect insulation maintained.



THE PERKINS ELASTIC RAILWAY CONDUIT.

THE ARMOUR INSTITUTE, CHICAGO.

WITH the University and Mr. P. D. Armour's latest gift, the Armour Institute, Chicago, seems destined to become noted for scientific as well as commercial enterprise. The building has been under construction for four years, and no one, except a few directly interested, knew of its purpose. The Institute is on the corner of 33d street and Armour avenue, being pleasantly situated in the residence portion of the city.

The building has four floors with a basement, and a power-house attached. It is built of brown stone and pressed brick, and the interior finished in white marble, The power plant is nearly completed, and consists of two Stirling water tube boilers and a 200 h. p. Hamilton-Corliss engine, which can be run either condensing or non-condencing. Rope transmission will be used to connect the engine with the line of counter-shafting. Four dynamos will be attached to this line by friction clutches. The dynamos will be both alternating and direct. Two will be used for lighting, one for power, and the fourth for experimental purposes. All the machinery in the laboratories will be operated by motors.

In the basement there are rooms for wood working, founding, forging and drafting, and several store and tool rooms. On the first floor, there will be a mechanical laboratory and machine shop, the office of the President and the general library. The second floor is devoted to the departments of electricity, chemistry and physics, each with ample laboratories and lecture rooms.

There will be fourteen more or less distinct departments, but the aim of the Institute is to become a technical school of the highest grade. The technical courses will be in mechanical and electrical engineering, physics and chemistry. A department of fine arts and architecture is contemplated. In addition, there is a school for librarians and a department of domestic science.

The faculty, as now organized, includes four professors, four directors of departments, four instructors, two assistants and an engineer. It is intended to equip each department with the best apparatus obtainable, so that unsurpassed facilities for instruction and investigation will be offered.

The appointments for the scientific faculty are, Victor C. Alderson, of Chicago, professor of mathematics; James C. Foye, of Lawrence University, professor of chemistry; Wilbur M. Stine, of the Ohio University, professor of Electrical Engineering; W. H. Runyon, of Chicago University, instructor in physics; E. W. Cooke, of Chicago, director of School of Mechanical Engineering.

The library system of the Institute is expected to be of especial value. Each laboratory will be provided with a complete technical library, and in addition, there will be a general library, of literary, historical and scientific works.

SOME EXPERIENCES WITH THE ALTERNATING SYSTEM.[1]

BY R. H. STERLING.

OUR company was among the first to install a large alternating plant—the largest, I believe, at the time in the United States. How wise we were in doing so I will answer by pointing to the enormous growth and success from the start of alternating current lighting, and its finally being fostered by those who were at first its bitterest enemies. We did experiment some, I will admit. A few minor details in apparatus did not just meet the requirements for practical use; but our parent company has always been willing to adopt the suggestions of its users and remedy defects discovered by them—a plan, by the way, which should be followed by all who manufacture apparatus—for the central station men are those who are best able to judge its merits and criticise it from all sides.

I will now take the principal features of an alternating station in detail, describing what have been our results and the best practice in my experience. I will begin with the switchboard. A circuit board is eminently better made of marble, as a matter of both safety, durability and appearence, and should have plenty of space between it and the wall. The dynamo bus wires should run in horizontal rows on the back, with plug holes extending through to the front, to connect to either side of each changing switch. There is a changing switch, of course, for each feeder or circuit, and all bus wires can be connected to any particular feeder. The front of the board should be divided into perpendicular panels, each panel representing a feeder.

On the back there will be the converter for voltmeter, compensating devices, etc., and the fuse blocks. These are preferably placed on the back, as it is an unpleasant thing to have a fuse blow in a man's face, and they should not be so high on the board that they cannot be reached standing on the floor. Many of you, undoubtedly, have had trouble with a fuse arcing, and finally melting the fuse block into a conglomerate mass, or setting fire to the switchboard. There are two simple remedies for overcoming this; one is to have all fuses covered with a piece of asbestos paper rolled around the fuse wire or link in the form of a tube, a little larger on the inside diameter than the wire, to allow for radiation of heat, so that the fuse will not melt under its rated capacity. These asbestos tubes are very easily made, and can be pasted either with shellac or silicate of soda, which is preferable, the idea being that when a fuse is blown, the pent-up gases in the tube are forced out at either end so violently that the resulting arc is dissipated immediately. I believe I am not the originator of this idea, but believe we can claim the use of asbestos as our own, and which is the only substance that is practicable.

Another simple plan to prevent arcing is to have all fuse blocks placed on a narrow shelf, with their faces up, as there is always a tendency in an arc to take an upward direction, owing to the current of heated air resulting from it, and in taking this direction there is a natural pulling away of the arc from the two metallic portions of the fuse block. Fuse wire as now made is quite reliable as to its carrying capacity, but, like many other good things, is not trustworthy, if abused. A lead fuse, either wire or flat link, should never be screwed down under a screw head and washer, no matter how small the carrying capacity it is intended for. This may do for a short time, but the soft metal soon loosens up, a poor contact is formed, and the fuse melts from the heat thus generated, causing no end of annoyance. This applies to the fuses, no matter where they are used, all over the circuit. The one way out of this is a small flat copper terminal, slotted to slide under the screw head, and soldered to each end of the fuse wire. The carrying capacity of the wire can be stamped on one terminal. These are cheaply made. A boy with a punch and die can stamp out many hundreds of them in a day, and the soldering, with a little experience, is rapidly accomplished. Had we adopted these fuses when we first began to furnish light, five years ago, and insisted on all inside wiring being fused in this manner, we should have been many dollars ahead to-day, and there would have been fewer lights out during that time.

Nine-tenths of the calls on our complaint book show a record of fuses blown in branch or main blocks of inside wiring, which we have to send men out to replace, and from repeated inquiries from these men, I find that this same proportion of nine-tenths would hold good for fuses that had blown or rather melted from poor contact, due to lead becoming loose under screw heads, and from no cause of short-circuits, overloading or trouble in the wiring. We now compel all wiring contractors to use a copper terminal fuse, and we ourselves replace all blown-out ones with this style; but with seventy-five thousand lights connected up, we do not see our way clear to weeding out the old fuses just at present; so let this be a warning to those young in the business.

On the front of the switch-board we have for one section or panel a volt and ampere meter for every feeder, one over the other, and surmounting these a pilot lamp run from the converter supplying the voltmeter, whose primary should be tapped on the feeder wires above the fuse block so that should a fuse go out quietly, as is generally the case when fuses are arranged in the manner I have mentioned, the attendant's attention will be called to the fact by the extinguishing of the pilot lamp. The changing switch, generally placed on the front of the board for each feeder, should be about breast high, so as to be easily reached to make a quick throw. I say usually placed on the front of the board, as it is only recently that a new switch has come out that has its jaws and contacts so arranged that it can be placed on the rear of the panel, with the lever extending through a slot to the front of the board. This is a matter of great safety to the switch tender, for, as stations increase in size and load, a new element of danger sometimes manifests itself in the act of throwing these changing switches. A violent arc is formed which follows across from one set of contacts to the other, throwing two dynamos in multiple through the medium of this arc, burning the attendant's face and hands and sometimes wrecking an armature, as, of course the two dynamos are not apt to be in synchronism when thus thrown together. Placing the switches horizontally will lessen greatly the continuance of this arc, on the same principle that I have mentioned the placing of fuse blocks on the switchboard with their faces up, and a fibre or slate partition between the jaws will prevent the arc short-circuiting the dynamo. This annoyance is only met with on feeders of considerable length and those having a large number of converters on them. It is due to the inductive discharge from converters and line, and is similar to the extra current or field discharge of a dynamo. Its occurrence depends largely upon the period in the wave phase at which the circuit is opened, and is proportional to the length of the circuit and the number of converters connected on the line. I have found this discharge to occur more frequently on circuits whose converters were partially loaded. This would naturally seem to be the result when the secondary coils of the converters were exerting no action on the primary, but I have had the most severe arcing on circuits with heavy loads. The damaging result of these arcs, however, has been entirely overcome since placing the switches horizontally, as I have described.

I have spoken only of the feeder ammeters. There should, of course, be an amperemeter for each dynamo. These are preferably placed together in a group at one end of the board, so that at a glance the attendant can see what load he is carrying, or on what dynamo there remains room for more feeders as the load comes on or goes off. The regulators and rheostats can be placed at the base of the switchboard, or, much better, if there is room, in a compact row out in front of the board about four feet, on a strong framing of wood or iron, so that all the voltmeters can be watched at the same time that the adjusting of the pressure is taking place. This saves the annoyance of the attendant jumping from the rheostat out to the front to catch a glimpse of the voltmeters to see how near he has come to guessing at the right amount of resistance he should have thrown in or out. The result will be far better service if the rheosats are thus arranged.

This now brings us up to the remaining feature of the switchboard—the lightning arrester—though I cannot say that, necessary as this last-named appliance is, the switchboard is the all important place for it. There may, however, be a lightning arrester on each side of every feeder, placed in a row on the top of the board, or on the wall back of it, and a heavy copper wire running along past this row and connected to each arrester with a tap wire, and the main wire leading to a good ground in as straight a path and with as few crooks and turns as possible, as every bend offers a source of self-induction detrimental to the flow of the lightning discharge. The source of ground cannot be too perfect; have several of them radiating off to different points, to a mass of metal in a well, or soldered to a water main, so, should one fail, the other may be relied upon. The lightning arrester itself should be an instrument devoid of fuses, capable of rupturing instantly the arc is formed, and still remain set for a second discharge; should be free from all moving parts; not absorb energy, and should be so reliable and substantial that it could be set up anywhere on the line and forgotten, and still perform its duty. This may seem to you like an ideal instrument, but, so far as alternating currents are concerned, I am positive that this state of perfection has been attained in a certain arrester now on the market. There is no question about the efficacy of lightning arresters placed out on the line, if we wish to keep the lightning out of the station and protect our converters, especially in districts remote from other wires and tall buildings, as in the residence portion of a town. It is a good plan to place one at the end of each feeder and branch main, and scattered at intervals midway on the circuit; they also are a wise protection over a large bank of transformers, notwithstanding the fact that we are taught to believe that lightning abhors an inductive resistance as nature does a vacuum, and that a collection of such resistance would be self-protection, yet it does not prevent the discharge entering the case of the converter; then it does not have to jump much more than the space of one-eighth of an inch over to the plates to ignore these inductive coils, reach the secondary outlets, and thence to the house wiring, when it generally finds an easy path to earth with the close proximity of inside wires to gas and water pipes, and especially on combination fixtures with poor insulating joints. This does not always completely burn out the converter, as oftentimes this discharge has only ruptured the primary coils on the first turn of the wire at the point where it has jumped to the frame holding the plates, and is easily repaired. I imagine this is the case when a discharge takes place when there is no dynamo current on the lines; at other times there is a complete destruction of both coils. In a great many instances we have traced converters burned out by lightning to defective insulation in the house wiring. Whether the ground actually existed before the disruptive discharge, or was caused by it, we could not always tell. I did find one place where the wire was fused to a gas pipe up in the attic, the discharge evidently having jumped through the insulation, as the wire had been carelessly left resting on the pipe. Of course, the primary fuse, having blown in the burning out of the converter, did not leave the circuit permanently grounded. We do not want the house wiring a safety valve to relieve the circuits of their static charges, therefore, having lightning arresters, plenty of them, that will offer an easier path to earth across small arcing gaps, smaller than can be found in the converters; but no matter how perfect the arrester is, it is valueless unless it has a good ground connection and a straight copper wire, not smaller than No. 6, without bends or turns, connecting the two. A very convenient method I have found to make a reliable earth connection for arresters out on the lines, is to dig a hole at the foot of the pole about two feet in diameter, three feet deep, and driving down through it a twelve-foot length of 1¼ inch galvanized iron pipe, having on the lower end a driven-well point to allow it to be driven easily, and a cap screwed on the upper end to prevent the sledge hammer splitting the pipe. The No. 6 wire can be more thoroughly soldered to the pipe before it is sunk.

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[1] Abstract of a Paper read before the National Electric Light Association, St. Louis, Mo., February 28 to March 2, 1893.

The upper end should be driven to about one foot below the surface, and the hole filled in with finely broken coke, which increases the conducting surface at that part of the earth that is the dryest, and the lower end of a twelve-foot pipe will usually be in moist earth, and can be relied on to furnish a good connection at all times. I once had an electric light man tell me that he considered a small coil of wire buried just under the surface of the earth sufficient grounding, as the rain would immediately soak the earth and make all the ground he wanted. I have observed severe lightning discharges that took place before a drop of rain had fallen.

While on the subject of the burning out of converters, I will mention an annoyance we sometimes meet with in a primary fuse blowing, arcing and welding the leading-in wires to the case, or so carbonizing the fuse box that a short-circuit is formed on the line. This will always be the case where the fuse carrying a high potential current blows in a pent-up space, with no chance for the gases to escape. The arc is being fed, and increases until a fuse is blown at the station and shuts off the supply of current. Generally, on throwing in this feeder again, after replacing the station fuse, it will be found to work all right if the wires are not fused to the converter case, or everything is not carbonized inside. We have in some instances, on its again blowing the station fuse, fused up a little heavier and finally removed the trouble, not fusing to that extent that it would wreck the armature. We are learning now that it is far preferable to have no primary fuses in the converter case, but a large primary fuse and switch box combined, removed from the converter to protect it. We have long since discarded secondary fuses in converters, replacing them with copper wire; and let me remark here that this is what a member of this Association meant when he made the statement before one of its conventions that we had been substituting copper wire for all our primary fuses, he evidently mistaking the primary for the secondary end of a converter. This would also be a sad mistake to make when fooling with hornets.

This short-circuiting of the line by the burning out of converter fuses and other causes led me to adopt a combined switch and fuse box on all branch lines leading from the main feeders, and we have found them of immense benefit. The switch cuts off all connection from the line wires in fusing up, and also makes a convenient means of disconnecting that part of the circuit to locate grounds and other trouble. Then the greatest advantage is their blowing when there is a short-circuit on the branch they protect, thus preventing every light on the rest of the circuit going out by the station fuse blowing. Then, again, it locates at once where the trouble lies by sifting it down to one of, say, twenty branch mains, by telephone calls pouring in that lights are out at such a place.

As alternating stations increase in size and larger units of dynamos are adopted—which is certainly a very wise step towards economy—another class of appliances is required at the switchboard, namely, devices for independently regulating the state of pressure on any particular feeder, the dynamo pressure remaining the same. The necessity of this can readily be seen, for we will have, say, on the same dynamo, when it is of large capacity, several feeders of different loads; those carrying the greatest number of amperes requiring a higher electromotive force to overcome the drop on line, so that if this required pressure all came from one source, these feeders of lighter load would be receiving to much potential, and a large lamp breakage would be the result. Therefore, the potential of the dynamo is regulated for the lighter feeders, and pressure raisers or "boosters" used to bring up the potential still higher for the remaining feeders. The principle of these regulators is this: If we take a converter whose capacity equals the maximum load of the circuit and connect the secondary in series with one side of the feeder, and the primary across the two sides, we are then adding the fifty volts of the secondary of the converter to the 1,000 volts of the line, raising its initial pressure five per cent. Adding a number of these in series in like manner, and having a suitable switch to throw them in or out in succession, makes a very convenient means of raising the voltage, but resembles somewhat, as I once heard it remarked, a man raising himself up by his boot straps. I have sometimes found it very useful connecting in ordinary converters at the switchboard, for temporary heavy loads, in this manner, where feeders were not provided with the regular "boosters."

Reactive or choking coils may be employed instead of "boosters," with the same end in view—*i. e.*, the proper adjustment of pressure on feeders of unequal drop supplied from one source—only in their use they will be placed on the lighter feeders and the dynamo be made to raise the E. M. F. for those having the heavier load. The first cost, I think, would be in favor of the reactive coils, but the relative economy in energy consumed would be slightly in favor of the pressure raisers.

A serious annoyance is often met with on the line from the inductive effects of two parallel circuits upon each other, causing the lights to waver, or "pump," which better expresses it. When this trouble first manifests itself in a station, the engine is generally the first thing to be blamed, and the engineer is caused many sleepless nights or days in trying to remedy it. We seldom find this effect in small stations, unless the feeders are parallel to each other for a considerable distance. It is most marked in circuits that are parallel and one of them carrying a heavy load, which exerts this inductive influence on neighboring lines on the same principle as the primary coils of a converter inducing currents in the secondary parallel to it; only in the case of this action on the lines, where each line is fed from a separate dynamo their phases, of course, not corresponding, we have in this cross-induction a very unsteady action in the current. Annoying as this trouble is, it is one of the easiest to remedy. First, see if some combination on the switchboard will not bring about a change in affairs. Ascertain if the several lines on which this trouble is noticed cannot be all run on the same dynamo; but if this should cause this induction to appear on other circuits formerly free from it, then the remaining way is to transpose the circuits midway between the starting point and where they cease to run parallel, by inserting a break arm in each side of the line, and joining in the shape of a cross the four ends thus formed. This will neutralize and break up the trouble completely.

These topics I have touched in my paper have been chosen as those most interesting and worthy of discussion, and with the hope that they will be of benefit to some of you, and call to mind other experiences I have not mentioned, which, if given freely before a body of this nature, will help bring about the results we are all striving for—good service and dividends.

MORALS OF CORPORATIONS.[1]

BY E. A. ARMSTRONG.

A CORPORATION is best defined by saying it is an artificial person, possessing certain limited rights, powers and privileges with a life, varying in each case from a few years to perpetual existence.

That there is a popular distrust, if not actual hatred, of corporations as such is undoubtedly true. I suppose a myriad of causes may be found and properly credited as the source of this.

A corporation of to-day, however, is vastly different from those not half a century old. In most of the States I apprehend their creation is very similar to that of my own State, New Jersey. With us corporations are formed under general laws passed for particular classes. A corporation may be formed for the desired purpose by making and filing articles of association setting forth the prescribed requisites. When this is done, by operation of the law, a corporation is formed. For many purposes only three persons are required. There is no charter, no grant, no executive, legislative or judicial act required. To be sure I speak of the present. Before 1875 it was possible to obtain a special legislative act of incorporation. Now, a corporation being created this way, is it just or reasonable that it be condemned *per se*? I cannot think that it is, because the inherited antipathy is both unjust and unreasonable. It is not, nor can it properly be, a class condemnation even should individual cases merit it.

If in this age and this presence I should say that this country owes more to corporations than anything else, I don't know how I should be regarded. In some places I know that if I desired to retain as much popularity as any man ought to court, that is, enough to live peaceably beside his neighbor, I would not dare say it. But would it not be true? These same people who in one breath condemn corporations in the other deify co-operation. Crucify the doer and crown the deed. Co-operation has been, and in all probability will be, in all ages the panacea offered for most of the social ills of the time. We are wont to deprecate, and rightfully, too, I think, disjointed individual effort. Guerrilla warfare, while exasperating and annoying to the enemy, accomplishes very little. Less than a hundred organized, drilled and experienced men may readily put a thousand in a mob to flight. The same will hold good in economic and business relations.

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[1] Abstract of a Paper read before the National Electric Light Association, St. Louis, February 28 to March 2, 1893.

If, then, so far I am right, the conclusion follows that a corporation is a desirable and a necessary thing to accomplish the greatest good with the least expenditure of energy and wealth. If what I have said does not prove that to your satisfaction, I shall want you, for the sake of my argument, to assume with me it to be proved, for I propose to so consider it. Now, then, comes my application, and I propose to consider it in two aspects. The first are the moral obligations *from* a corporation to the public, first, and then to the individuals composing the public. The second are the moral obligations *to* a corporation from the public, first, and then from individuals, as they can best be considered together. I shall not formally group or place these two headings, but run them right together. Nor do I propose to deal with corporations generally; but, as this is the National Electric Light Association, I propose to consider electric light companies particularly.

The quasi-public character of much of the business of almost every electric light company in its dealings with municipal authority must be emphasized. Every company doing such service occupies such a position of trust as to require it to give a maximum of service at a minimum of cost. Don't misunderstand me. It is not only the privilege of an electric light company to receive, it is its duty to demand fair compensation for what it provides and furnishes. It is just as dishonest for it to take advantage of its position and crowd the municipality as it is for the municipality to reverse the tables. We have often taken occasion to complain of the unfair treatment given companies by municipalities, but too often the treatment has been invited. When a corporation such as ours makes a large investment for public lighting, and while it continues to regard what I have indicated as its duty regarding service and charges, it has the right to expect a continuance of the municipal—patronage, I was about to say—service, I will substitute. Any deviation from this, while not a violation of an express, is the violation of an implied contract; something in law just as binding when defined, and, therefore surely ought to be in morals.

Such, briefly, is the way in which our corporations and our governments should regard each other, as I take it. Be mutually regardful of the duties and responsibilities of each other and properly regarding their reciprocal obligations. Each one can further carry out the argument to his satisfaction.

That there is, to a wonderful extent, this appreciation of obligation on the part of the companies is a thing very pleasant to contemplate. If accident or disaster happens to a company, just see what heroic effort is put forth to remedy it. Men and money are never spared. The inquiry is made, Can it be done? And if it be answered affirmatively, immediately comes the decree: Then do it. A notable instance of this, the latest of many coming under my observation, be it said, is that of the Buffalo plant. Our friend and former president, Mr. Huntley, worked with more than his accustomed vim and vigor to make his plant a Phœnix, and did it because his first desire was to serve his city. Say what you will, gentlemen, this is patriotism

It is the duty of our corporation to use the best methods it knows or can learn, adopt all the improvements, and render the best possible service, and that at as reasonable a figure as it can afford to do it, having a just appreciation of the risk the capital invested sustains, which is entitled to an adequate return, If you can furnish light or power at a less figure than you are now receiving, and still pay your stockholders a fair return, it is your bounden duty to voluntarily reduce your prices, so that those who make your business possible may have their share in your prosperity.

So far as I have been able to learn from observation, central station companies of themselves have been very considerate and mindful of each other. The poaching has been at a minimum. To be sure, I exclude from this entirely the *assisted* and *inspired* organizations that masquerade under the name of local companies. This amicable and creditable feeling is, as I take it, largely due to this association and to our electrical papers. The more people know and learn the more tolerant and less bigoted are they.

There is one branch of this subject I have not named, and that is the attitude of the parent and supply companies toward the companies of our association. They, of all people, ought to have regard for us. Indeed, they have in times past had the greatest regard for us, in fact, quite an *absorbing* regard.

I do not think that I ought to prolong this further. I only want to emphasize the fact that because men are associated in a corporation, and, therefore, lose some financial responsibility, they do not thereby lose also all moral responsibility.

As corporations we can do what as individuals would be impossible. The aggregation of the littles will accomplish wonders, just as brick after brick makes the tallest and grandest structure. But the beauty and the strength and, indeed, the utility of the world is absolutely dependent upon the perfection of the single one, the individual. Therefore, fellow stockholders and officers of corporations, in all these things "Be ye perfect."

WROUGHT VERSUS CAST IRON FOR FIELD MAGNET FRAMES.[1]

BY A. D. ADAMS.

THE aim in this paper is to point out some of the advantages of wrought iron over cast iron for the field magnet frames of bi-polar dynamos. The researches of Prof. Ewing and Dr. Hopkinson show that the same magnetizing force per unit of length, as measured in ampere turns, which produces in good hammered scrap iron a magnetization of 100,000 lines per square inch, produces in good gray cast iron only about 42,000 lines per square inch, and these values are about as high as we can go in either of these metals and get anything like a proportionate increase in magnetism for increase in magnetizing force. If, then, the same number of ampere turns are to be used for a given length of magnetic circuit, cast iron must be about two and a half times the section of wrought iron. Since the field magnet, to have the same magnetic carrying capacity at the same permeability, must have about two and a half times the section when made of cast as when made of wrought iron, the weight of cast iron for the same type and capacity of machine will be about two and a half times that of wrought.

In order to compare the relative amounts of copper required in field magnet windings for machines of the same capacity, but with different metals in the field magnet, the same wattage or exciting current must be assumed for all types. Take two machines of the same type and capacity, with the same length and section of air gap between the armature core and pole pieces and let one field magnet be made of wrought and the other of cast iron, throughout, each having the field magnet core circular in section and the area of the cast iron core two and one-half times that of wrought. Since the ampere turns required on each magnet are equal, also the watts expended in winding, there will be the same number of turns of wire on the cast iron as on the wrought iron field.

As the two field cores are circular in section and one two and a half times the area of the other, the length of wire required around the cast iron will be to that around the wrought iron core as $\sqrt{2\frac{1}{2}} : 1.$

Since the weight of copper required to transmit a given amount of electric energy at a given pressure and loss varies as the square of the distance, the weight of copper on the cast iron will be to the weight of copper on the wrought iron core as

$$(\sqrt{2\tfrac{1}{2}})^2 : 1^2 - 2\tfrac{1}{2} : 1.$$

The general practice among American manufacturers of bi-polar dynamos and motors is to use either cast iron entirely or cast iron yokes and pole pieces and wrought iron cores. In the latter case the sections of the cast iron parts are usually made only about one and a half times that of the wrought iron.

With these proportions between the wrought and cast iron either an excessive amount of magnetizing force must be expended to drive the magnetism through the pole pieces and yokes, or else the wrought iron core must be only saturated to a very low degree. The amount of copper or field current must be, in either case, considerably increased above that required when the cast and wrought iron parts have their correct relative proportions. Magnetic leakage is considerably increased by the use of cast iron, as compared with wrought iron, by reason of the greater surface of cast iron, also the much higher relative degree of saturation at which it is frequently used.

It is evident from the above that the weight of iron and copper for the field magnet and winding in a machine of given capacity are both more than twice as great when cast as when wrought iron is used entirely. When the field magnet is made partly of cast and partly of wrought iron, the increase of iron and copper is not so great and varies with the relative section of the cast and wrought iron parts. The advantage of wrought iron over cast for the field magnets of bi-polar dynamos seem to be more generally appreciated in England than with us, as nearly all the leading makers of such machines there use forged wrought iron entirely for field magnet frames. As the relative magnetic value of wrought and cast iron become more generally appreciated by dynamo builders in this country, the former will, no doubt, be much more generally adopted.

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[1] Abstract of a Paper read before the National Electric Light Association, St. Louis, Mo., February 28 to March 2, 1893.

The following data of a two horse-power, 110 volt motor, designed by the writer, and having a forged, wrought iron field magnet throughout, may be of interest as illustrating some of the above points:

Type of motar, bi-polar. Type of armature, smooth core Gramme. Weight of motor, 250 pounds. Speed of armature without load, 1,700 revolutions per minute. Turns of wire on the armature, 360. Size of wire on the armature, No. 15 B. & S. gauge, Weight of armature wire, $3\frac{7}{10}$ pounds. Resistance of armature, cold, $\frac{38}{100}$ ohm. Resistance of field coil, cold, 140 ohms. Current in field coil, $\frac{78}{100}$ ampere. Wire in field coil, 26 pounds No. 21 B. & S. gauge.

Particular attention is called to the number of turns on the armature of this machine, namely, 360, which is very small when its weight and the moderate speed at which it runs are taken into consideration. It is very evident that these results could not have been obtained had cast iron been used, either wholly or in part, for the field magnet.

It may be pointed out that the weight of wire and the energy required for field excitation might have been considerably reduced had it been thought best to reduce the length of the air gap, but it was desired that the field exciting force should practically overcome the tendency of the armature to distort the magnetic field in the air gap, which result has been obtained by the above construction, so that no change of lead, with the brushes, is necessary when the load of the motor is varied from nothing to its full capacity.

THE VULCANIZING PROCESS FOR PRESERVING AND STRENGTHENING POLES, CROSS ARMS, TIES, ETC.[1]

BY HARRY C. MYERS, PH. D., F. C. S., ETC.

WHEN we consider that the annual consumption of timber in this country equals twice the amount of material supplied by the annual growth of our forests, it is apparent that the subject of wood preservation, wood strengthening and the utilizing of certain woods now considered as worthless, is a most important and vital one.

Wood as it occurs in nature consists of cellulose impregnated with resin, volatile oils, sugar, gum, tannin, protein bodies and the usual mineral constituents of plants. The percentage of these various constituents, of course, depends not only upon the kind of wood, but upon the season of year, locality, nature of the soil, and part of the tree from which any given sample is taken, hence any results or tests would be only approximate ones.

When wood is heated, as in ordinary wood distillation, the cellulose decomposes and a chemical change takes place between it and the natural constituents of the sap, resulting in a most powerful antiseptic mixture containing acetic acid, methyl alcohol, acetone, methyl acetate, tarry matter containing phenol, creosote, carbolic acid and about 30 other chemicals of lesser practical importance.

The following percentages by weight were distilled from various woods:

Yellow pine	57.8 per cent.
Norway pine	56.8 per cent.
Virginia pine	60.2 per cent. to 72.1 per cent.
Red oak	55.3 per cent.
Spruce	58.7 per cent.
White pine	61.2 per cent.
Poplar	59.0 per cent.
Cypress	59.0 per cent.

It must be borne in mind that these chemicals and antiseptics result from the action of *heat* on the natural sap of the wood, and are *entirely different* from the original sap which allows of the attack of microscopic fungi and decay. Why has it occurred to no one to heat timber at a temperature which would produce the above change, and then to *keep the changed antiseptic mixture there under pressure*, instead of destilling it *out* of the wood? Such is the entirely new and original process known as "wood vulcanizing," viz., the heating of wood and timber under great pressure.

Hundreds of processes for preserving wood have been patented, and all of them may be divided into two classes: I. Those in which wood is impregnated with a preservative material by immersion. II. Those in which a preservative agent is forced into the pores of the wood. Such chemicals as copper sulphate, zinc chloride, mercuric chloride, dead oil, etc., have been applied, but experience and results have failed to prove them all that is to be desired in an economic and effective means of wood preserving. The poisonous nature of such chemicals makes the application and use of them very objectionable.

In the process of "vulcanizing," wood is heated in closed cylinders from eight to twelve hours at a temperature ranging from 300 degrees to 500 degrees Fahrenheit and under a pressure of from 150 to 200 pounds to the square inch. A circulation of superheated and dried compressed air removes the surface moisture and any water that does not take part in the reaction and combine with the woody constituents. Hence, wood or timber, in any condition, may be immediately treated. These cylinders for the treatment are 105 feet long, $6\frac{1}{2}$ feet in diameter and are made of steel. As the treatment penetrates to the heart of the timber, considerable time is required for cooling, which is, of course, done in the cylinder and under pressure. Timber is introduced and treated upon cars which run into the cylinder upon small tracks. The percentage of dark antiseptic matter contained in *vulcanized* woods I find to be as follows:

Vulcanized yellow pine	55.3 per cent.
Vulcanized Norway pine	56.7 per cent.
Vulcanized Virginia pine	58.9 per cent.
Vulcanized red oak	54.0 per cent.
Vulcanized spruce	57.9 per cent.
Vulcanized white pine	55.5 per cent.
Vulcanized poplar	59.0 per cent.
Vulcanized cypress	56.8 per cent.

The samples from which these results were obtained were companion pieces to those from which the previous were obtained; a comparison shows the percentage of moisture removed by the vulcanizing process.

This process apparently makes decay impossible by sealing up the pores of the wood with antiseptic matter which becomes solid and firm on cooling and standing, and which is produced *within* the wood by the action of heat and pressure upon its original sap.

The original sap is colorless or pale yellow, and the changed sap very dark or black, hence a most desirable dark antique color may be imparted to oak and other woods.

The following tests were made at the School of Mines, Columbia College by request of the Western Union Telegraph Company, upon cross arms to be used on telegraph poles.

In each case two cross arms were made from the same piece of timber; one was vulcanized and the other left untreated. Results below give, in pounds, the weight required to break each cross arm:

Vulcanized Norway pine	3,000 pounds.
Natural Norway pine	2,680 pounds.
Vulcanized cypress	2,600 pounds.
Natural cypress	1,860 pounds.
Vulcanized spruce	2,780 pounds.
Natural spruce	2,460 pounds.
Vulcanized poplar	2,840 pounds.
Natural poplar	2,560 pounds.

These startling results show an average *increase* in strength of 18.9 per cent. Similar tests made by Prof. R. H. Thurston and Mr. Alfred Trautwein, of Stevens Institute, verify the above results.

The Hon. B. F. Tracy, Secretary of the United States Navy, with a view of adopting vulcanized wood in naval construction, appointed a committee who visited the vulcanizing works in New York City, made tests of their own on yellow pine, showing an average increase in strength of 18 per cent. and a decrease in deflection of over 13 per cent.; hence, they reported that vulcanizing increases the durability and strength of timber, and recommended such timber for use as backing in one of the monitors.

Untreated cross arms which had been painted and used by the Bell Telephone Company for from two to three years showed, by actual test, an average *decrease* in strength by exposure of 18.78 per cent., as compared to new untreated cross arms. Other pine cross arms which had been in service on Western Union telegraph poles for three years and over showed an average loss in strength by exposure of 38.12 per cent. The process of vulcanizing seasons all timber, thoroughly preventing any further warping, checking or cracking. Such timber is not influenced by atmospheric agencies, bacteria or spores, and requires no paint for protection, as it is saturated with antiseptic preserving material of its own; the albuminous constituents of the natural wood have been coagulated by the high heating and rendered insoluble.

Loblolly pine, as it is used in the South, decays in about three years, and is unfit for any railroad construction where it is exposed to the elements. Other woods are seasoned and rendered beautiful by vulcanizing, which produces very desirable colors for interior decoration.

The life of vulcanized timber is not known; none of the timber or ties used in railway construction during the past 10 years have been known to decay. I personally examined some 12 x 12 pine timber which had been placed in a machine shop in 1882, part being vulcanized and part untreated. The treated timber is perfectly sound and still in use, while the untreated had completely rotted and crumbled away after five years' use. I also find by personal investigation that timber placed on the Manhattan Elevated Roads of New York City, as far back as 1883, shows no signs of decay, and is as sound and sweet as if fresh from the tree, while untreated timber laid at the same time has rotted away and been replaced.

As vulcanizing changes the sap from the liquid to the solid or semi-solid state, does not char or make the wood brittle, saturates and seals up the pores of timber with solid matter instead of liquid soluble matter which nature provides, considerable strength and durability are added by vulcanizing, the wood being rendered more cohesive, harder and denser. The spike holding quality is naturally much increased, and even after 10 years' service, railroad spikes seem to be as firmly imbedded as when just driven.

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[1] A Paper read before the National Electric Light Association, St. Louis, Feb. 28 to March 2, 1893.

It is also a curious fact that the electrical resistance of most woods is very greatly increased by vulcanizing.

RELATION OF INSURANCE TO ELECTRIC LIGHTING AND POWER [1]

BY WM. BROPHY.

THOSE engaged in the insurance business and those engaged in the manufacture and sale of electric lighting apparatus, as well as those who furnish electric light and power, have one common end in view, viz., to secure at least a fair return on the capital invested in their business and for their own time and labor. Each of these interests needs the help of the other, and there is no good reason why one should antagonize the other. That this has been done in the past I will not deny, but to say that the insurance companies were wholly to blame for their hostility to the introduction of the electric light would be manifestly unfair, to say the least.

Insurance companies have paid dearly in the past for the mistakes of those engaged in the introduction of all modern forms of artificial illumination and many forms of heating, a few of which I will here enumerate. Since the days of the tallow candle and whale oil lamp, we have had gas, camphene, burning fluid (rightly named), kerosene, refined petroleum and its products—naphtha and gasoline—some of which have caused enormous losses by fire to the owners of property and insurance companies, and the loss of thousands of human lives.

After these costly experiments, was it to be wondered at that the insurance interests should view with mistrust this new and mysterious force, electricity, when the attempt was first made to work it in harness to furnish light?

How to deal with this new and to most people's minds dangerous element was a most serious question with the underwriters of this country. To many it seemed best to increase rates all along the line where it was introduced, and thus prevent or discourage its use. Had such action been taken there is no doubt but it would have had the effect of retarding the growth of the electric lighting business very greatly indeed. Fortunately, this last expedient was resorted to in only a small portion of this country.

In that little corner of our great and glorious country known as New England, the insurance organization known as the New England Insurance Exchange was most fortunate in its selection of a chairman for its then new committee on electric lighting. He found time while performing his regular duties as a special agent to post himself up in the mysteries of dynamic electricity, and as his knowledge increased his friendship for this form of illumination and those engaged in producing it increased in like proportion.

To those inspectors who are engaged in an attempt to throw discredit on those engaged in the electric business, by practically saying, "You are not to be trusted," I will say, Beware, the electric industry is not the puny infant it was some ten years ago. Millions are now invested in it, while the phenomenal growth of the electric railway challenges the admiration of all, and it is fast attaining the vast proportions of the electric lighting industry. These joint industries will submit good-naturedly to all reasonable requirements exacted by your employers, but they cannot be expected to submit to continual annoyance or admit that they are unable to conduct their own business much longer by those who seek to do so by might and without a shadow of right. The electric light business can exist without the fostering care of these self-appointed guardians, who seek to magnify their own importance by throwing discredit on this association. Because they are tolerated they must not seek to dictate, as there is a point beyond which forbearance ceases to be a virtue with all classes, and the electric lighting companies do not differ materially from the rest of the human family in this respect.

Having given you a little of the early history of the combined efforts of those who sought to make the electric light safe in its early days, and pictured some of the obstacles that had to be met and overcome, I will try to point out the best methods to pursue to stop the silly twaddle about the dangers of electric lighting by professional agitators, sensational newspapers and timid old ladies of the male persuasion, and deprive the smart (?) insurance man, who insist that there are hidden dangers contained in every portion of the plant, that compels him to charge an increased rate of premium for its production and use of his stock in trade.

In the city of Boston, the Board of Underwriters have for a number of years maintained a system of electric light inspection, paid for by assessments levied on electric lighting companies, also on firms and individuals engaged in electric construction. The city is compelled by State law to maintain a similar system of inspection. In addition to this, one of the electric lighting companies, whose officers are not possessed of an abiding faith in either of the above-named systems of inspections, makes it a point to inspect all wiring before they will connect thereto. Yet with all these safeguards and checks on those engaged in electric ligting and construction, some men "claim to see a connection between the growth of the fire loss and the growth of the use of electricity."

The real fact in the case is that millions of insurance has been placed by the agents and brokers on property that is far more hazardous than the very poorest electric light plant in the business portion of the city in question; ordinary prudence having been thrown to the winds in writing such insurance, the inevitable consequences of such folly ensue, viz., disastrous fires. The agent who sees a possible loss of commissions hastens to give a plausible excuse to his companies, by charging the origin of the fires to electricity and demands an investigation of the fire department for not extinguishing them before they were kindled, concealing the fact that his own methods of placing insurance encourage incendiarism and promote carelessness.

In view of the fact that it is now proposed to add a small charge to the rate of insurance where electric lights "are installed in compliance with board rules and specifications," and a charge of 25 cents where they do not meet with the approval of the insurance inspector, I would advise you to pursue the following course:

Where a company does its own wiring for its customers, proceed with as much care as though the building in which you are installing wires and fixtures was your own, and you had no insurance on it. Where the work is done by others, inspect every foot of wire, every joint, cut-out, switch and insulator, and on no account turn on current until you are satisfied that it is as safe as it is possible to make it. Do not rely on the uncertain movements of the insurance inspector or any other system of inspection that too often fails to inspect. You are the one whose business will suffer from the bad effects of fires caused by defective wires.

We now come to the electric light station. Do not rent one end or the basement of a flour, saw or planing mill and place your machinery in it and expect to get any better than the rates charged on the buildings named above. While they are considered extra hazardous risks, insurance boards in their wisdom (?) will tell you that the introduction of electric light machinery increases the hazard and also the rate. This statement may cause you to smile, but there are those whose early experience have found it no laughing matter. Do not place it in some old abandoned building, for, as in the above case, an increase of rates will follow. Do not set your machinery down on the ground and build a tinder box around it, for besides assuring high rates of insurance it does not speak well for the business sagacity of the owner.

Proceed as though you proposed to do a legitimate business and for all time. Build your station on solid foundation, the walls of brick or stone, not over two stories high—better only one—solid brick or stone foundation for engines, boilers, dynamos and pumps; a solid brick wall extending three feet above roof between boiler and engine-room; the floor of boiler-room of brick, stone or cement; if the building is two stories high, have the boiler-room the same, having clear, open space between floor and roof; floors of engine-room, if dynamos are not placed therein, can be of iron or stone; if dynamos or other apparatus are in the same room, floor should be of three inch plank, tongued and grooved, with hard wood floor of one inch boards, matched and laid at right angles to, or diagonally on, the plank, the whole laid on heavy square timbers or iron I beams; the roof should be of three inch plank, splined and grooved, resting on square, hard wood timbers or trusses of iron or I beams; cover this with slate, tin or gravel, according to pitch; leave the walls bare; do not attempt to improve their looks by covering them with wood and creating concealed spaces; roof and ceiling, ditto; enclose stairways with plank, and provide self-closing doors therefor; cover the doors in brick partition walls with tin; also the frames; do not build a wooden hen-cup or Turkish pagoda on top of roof, and call it a wire tower; build from floor of dynamo room, of brick or tile, a good substantial tower, of ample size for all wires; put them in systematically and not by guess; make switchboard of good, hard, well seasoned wood, skeleton in form, or use the sides of brick or tile tower; if slate switchboard is used, bush all holes through which wires, plugs or other connections carrying high potential currents pass, with glass, porcelain or hard rubber; do the same if sides of brick wire tower are used; use this same material where wires pass through floors or other woodwork; secure a supply of water for protection against fire from town or city mains, if available and pressure is sufficient. In doing this have pipe leading into station of ample size. It costs no more to excavate for a six-inch pipe than it does for a one-inch, and the difference in cost of pipe is not enough to outweigh the value of an abundant water supply in case of fire, for, like the Texan's revolver, then is the time when you want it and want it bad. If water cannot be secured in this way, make your boiler pumps sufficiently large to throw, when connected together, or working singly, from three to five hundred gallons per minute, according to circumstances. Remember that all electric apparatus, including dynamos, is very susceptible to damage by fire or water, and by reducing the amount of combustible material in your plant you reduce the possibilities of a large fire and the necessity for a large amount of water.

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[1] Abstract of a paper read before the National Electric Light Association, St. Louis, Mo., February 28 to March 2, 1893.

Do not, if possible, build your station adjoining or too close to such risks as oil refineries, planing, saw, and flour mills, grain elevators, etc. If obliged to do so, have no, or as few, openings as possible in the exposed side or end, and provide metal covered shutters for these few. Run all your wires in plain sight, leaving ample space between them. In planning your station, allow for future growth and enlargement, without disturbing the present arrangement of machinery, etc. Store your oil, and, if possible, your other supplies, outside the station, and if you have a repair shop, do not have it in the second story, attic or basement. It is much better outside the building. If you must have it in the building, do not box it up out of sight, but separate it, if you must, by an open partition or fence from the rest of the building. Divest your own mind of the idea that dirt, grease and slush must be the wedded partner of an electric light station, and impress on that of your employés that an absolute divorce must be granted if the marriage ceremony has been performed. "Cleanliness is next to Godliness," but nowhere does this maxim apply with such force as in an electric light station.

Having finished your plant in accordance with the foregoing requirements, you need have no fears of acts of unneighborly conduct or apparent neglect of your property by the ever active insurance agents. Instead of waiting for you to see them out and beseech them to insure it, they will be as attentive to you as the most ardent young suitor ever was to his lady-love. Remember that so-called tariff rates and agreements, that hold insurance associations together for the purpose of maintaining high rates are but ropes of sand, and that keen weapon, active and oftentimes bitter competition, is continually cutting it up in little pieces and letting this craft, that should be rightly named "Trust," drift on the hostile shore of independent action.

REMARKS CONCERNING POWER TRANSMISSION FROM THE ECONOMIC STANDPOINT.[1]

BY L. B. STILLWELL.

AT the Buffalo Convention of the National Electric Light Association, in February, 1892, in the general discussion of the subject of electric transmission of power, a great deal was said about different systems of electric apparatus which might be employed for this purpose and various opinions were expressed concerning volts, amperes, cycles, alternating versus direct current systems, and one-phase, two-phase or three-phase machinery. The subject appeared to be one of great interest to the Convention, and the discussion was more or less instructive. But the writer carried away from that Convention the impression that after all the manager or owner of a central station, or the business man desirous of securing information as to the practicability of profitable investment, must have failed to derive any great amount of information of the kind which he desired to obtain. The first question of such a man is, Does it pay? and it is a question which an engineer who has become so involved in the consideration of technical points as to lose sight of the question of practicability from a business standpoint has great difficulty in answering. But the business man is right. "Does it pay?" strikes direct at the root of the whole matter. The practicability of all systems, and of all projects of this description must be measured in monetary units, and electric transmission of power, as well as every other form of engineering undertaking, must find its ultimate reason for existence in considerations of economy. Any engineering project which cannot live when measured by this standard should never be undertaken.

In discussing the subject briefly from an economic as distinguished from a technical standpoint, I wish to say at the outstart that I am aiming to obtain information rather than to impart it. The question which the practical man asks as to the economy of a project is the most difficult to answer. No answer that is perfectly general, and, at the same time, definite, accurate, and infallible, can be made. The problem, broadly considered, is one of extreme complexity, comprising a large number of factors and these are nearly all variable, whose actual values for any given case depend upon a variety of local conditions, the precise effect of which is not easily determined. Very few men, even among those who are actually operating central stations, are able to say exactly what power costs them, and it is not surprising that the engineer who is called upon to lay out, let us say, an elaborate plan for the utilization of water power finds it difficult to give explicit answers to questions relating to the cost of operating such a plant, probable revenue to be derived from the sale of power, and, in general, economic feasibility. It is safe to say that no perfectly general solution of the economics of central station operation can be worked out. Time, and the sure working of evolutionary law will some day clear away much that in the early days of a new business is inevitably more or less uncertain and speculative, but it is not to be expected that we shall even then be able to reduce these matters to fixed formulas. Of ten thousand plants the fittest will survive and pay dividends, and central station engineering will then consist of close study and careful analysis of the conditions and methods which have led to the survival of these fittest installations. In other words, central station engineering will then be largely imitation.

At the present time we find in actual operation a large number of central stations utilizing the energy of coal by means of steam plants, and distributing power and light through the medium of various types of electrical apparatus. The number of central station plants operated by water power is, on the other hand, extremely limited. There is to-day perhaps no question of greater interest to owners and operators of central stations than that of the relative economy of transmission plants utilizing water-power, and it will, therefore, be interesting to narrow the general problem of economics of central station operation in such a manner as to indicate how experience in the operation of the former class of plants may be made useful in predicting what will happen if water-power be substituted for steam. The best way to arrive at results of some tangible value is obviously to compare an hydraulic and electric transmission plant with a central station using steam engines to drive dyamos.

In the former we have the steam plant, consisting of boilers, engines, pumps, heaters, etc.; the electric generating plant comprising dynamos, exciters and all electrical apparatus located in the central station; and the distributing plant comprising motors, lamps, transformers, and the conductors connecting these with the central station. In the latter case it is usually convenient to locate a sub-station at a point adjacent to the market; for example, on the spot where the central station would be located were we to obtain power from coal. In such a plant we have the hydraulic apparatus, comprising dam, flumes, draft tubes, turbines, regulators, etc.; the electric generating plant, consisting of generators, exciters, and all electrical apparatus located in the generating station; the transmission circuits between generating station and sub-station; electrical apparatus in the sub-station, which usually consists of transformers employed to reduce potential, together with switching and regulating apparatus; the motors, lamps and other translating devices, and the local distributing circuits connecting these with the sub-station. We may assume that the two installations from the point where the local distributing circuits leave the generating station on the one hand, and the sub-station on the other to the premises of the consumer, are precisely similar. There is no reason why they may not be so, and since the whole installation, no matter which of the two alternative plans is adopted, must be designed to supply such service as the customer wants and will pay for, the assumption is perfectly fair. It follows that if the two contrasted plants are capable of delivering the same amount of power to the local distributing circuits they are alike as regards revenue. We may, therefore, at this point make our comparison still more direct by further narrowing the problem, disregarding the revenue side of the question, and comparing simply annual charges. It is obvious, also that it is unnecessary to compare annual charges upon that part of each of the contrasted plants which lies between the customer and the central station in the case of the steam plant, and between the customer and the sub-station in the case of the hydraulic and electric transmission plant. In other words, that phase of the general problem which I have selected as perhaps the most interesting may be stated as follows:

"What are the total annual charges against an hydraulic and electric installation utilizing cheap power at "A" and transmitting it to "B" as compared with the annual charges against a steam and electric plant located at "B," and capable of supplying the same amount of energy in equivalent form to the local distributing circuits?"

We may conveniently construct an algebraic skeleton or framework of the annual charges against each of these typical installations. When we come to translate algebra into arithmetic by substituting numerical figures for the algebraic symbols, opinions will differ widely as to the actual values of the different factors, but I think that the skeleton will be useful, as by discussing, and, if possible, fixing one factor at a time, we shall be better able to arrive at some approximation to a definite and tangible result. The method outlined in the skeleton-framework is, of course, the method which a competent engineer who may be called upon to make estimates of the operating expenses of such plants will adopt; that is to say, he will naturally consider each item of expense separately, and make his calculations step by step. But the proper factors largely depend upon results of experience in the operation of plants sufficiently similar to make inference from one case to the other fairly safe, and accurate data relating to such experience is at the present time very difficult to obtain. My object, therefore, in this paper is to invite your attention to each of the various items of expense in such installations, to obtain information from your experience and to suggest that it is in the power of the members of the National Electric Light Association to collect such a mass of data concerning the economics of central station operation, and the distribution of energy for light and power purposes, as will be of the utmost value in judging of the practicability of the thousands of projects of this description which will be under consideration within the next 10 years. It is also in the power of this Association to compare, analyze and arrange this information in such a way as to make its application to a new project direct and reasonably conclusive. If there be any means by which failure in ventures of the kind, in which you are and will be interested, may be avoided we should certainly put ourselves in possessison of these means as early as possible, and I would, therefore, respectfully urge the advisability of concerted action, looking to the collection and proper analysis of information concerning each of the various items of expense, and the various sources of revenue of your central stations. The problem is somewhat complex, and unless we have some definite and progressive method of analysis it is practically impossible for an association which may be considering the subject, or even for a select committee of engineers who may be called upon to advise with reference to a specific case, to arrive at an agreement in which all will concur. I believe, therefore, that we may make good use of the skeleton statement of annual charges.

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[1] A Paper read before the National Electric Light Association, St. Louis, Mo., Feb. 28 March 2, 1893.

In calculating the annual charges against the steam and electric plant we must consider the following :—

F_b = First cost of real estate and buildings.
F_b = Percentage covering interest upon and maintenance of real estate and and buildings.
C_b = Constant expenses, taxes, insurance, etc., on real estate and buildings.
F_s = First cost of complete steam plant, including engines, boilers, steam pipes, pumps, heaters, etc., installed.
P_s = Percentage covering interest upon and maintenance of steam plant.
A = Cost of fuel to produce one pound of steam.
S = Pounds of steam used per indicated h. p. per hour.
N = Number of indicated horse-power hours used per year.
W_s = Cost of water (if any) per annum.
O_s = Cost of oil and waste per annum for steam plant.
F_e = Cost of electric generating plant, including exciters, regulators and complete station equipment.
P_e = Percentage covering interest upon and maintenance of electric generating plant.
O_e = Cost of oil and waste per annum for electric plant.
C_{se} = Constant expenses including superintendence, wages, taxes, insurance, etc., steam and electric plant.

Then = $P_b F_b + P_s F_s + A S N + W_s + P_e F_e + O_s + C_{se} + O_e$ = annual charges.

For the hydraulic and electric plant we have the following :

F_b = First cost of real estate and buildings.
P_b = Percentage covering interest upon and maintenance of real estate and buildings.
C_b = Constant expenses, taxes, insurance, etc., on real estate and buildings.
F_h = First cost of hydraulic plant including turbines, dams, flumes, etc.
P_h = Percentage covering interest upon and maintenance of hydraulic plant.
O_h = Cost of oil and waste per annum for hydraulic plant.
C_h = Constant expenses including superintendence, wages, taxes, and insurance on hydraulic plant.
A = Cost of water per horse-power hour (where water rate is paid).
N = Number of horse-power hours at turbine used per year.
F_e = First cost of electric apparatus between turbine and local distributing circuits exclusive of line.
P_e = Percentage covering interest upon, and maintenance of, electric plant exclusive of line.
O_e = Cost of oil and waste per electric horse-power from generators for electric plant.
C_e = Constant expenses, including superintendence, wages, taxes, insurance, etc., on electric plant.
F_l = First cost of pole line, insulators and conductors.
P_l = Percentage covering interest upon and maintenance of pole line, insulators and conductors.
C_l = Constant line expenses (supervision and repairs).

Then $P_b F_b + C_b + P_h F_h + O_h + C_h + A N + P_e F_e + O_e + C_e + P_l F_l + C_l$ = annual charges.

And now, what have we accomplished? We certainly have not arrived at a definite solution of the problem of comparative annual charges, and the more carefully one looks at the statements, the more evident does it become that there are many factors the value of which can only be fixed by actual experience. It appears, however, that were we in possession of accurate and detailed data as to the cost, operating expenses and income of a steam and electric plant, we might form a pretty accurate idea of the practicability of an alternative project involving electric transmission of power. We should also need some information as to the cost of installing and operating hydraulic plants under various conditions, but this can be obtained with sufficient accuracy and with no great difficulty. The evolution of apparatus adapted to the efficient and reliable transmission of energy, and hence to the utilization of vast amounts of power in the form of falling water now wasted has reached such a stage as makes this question a most vital one, and the importance of information relating to the cost of steam and electric plants now in operation is manifest.

This paper is offered simply in the way of suggestion and for the purpose of inviting criticism and comparison of opinions. The skeleton statements of annual charges have been hastily prepared and may doubtless be revised and amended with good results. It is intended simply for classifying purposes, to facilitate the accumulation of much needed data and to avoid confusion of ideas in discussion of the problem which I have attempted to analyze. I sincerely trust that the suggestion will be taken up by this association and effective steps taken to increase our fund of observed facts based upon experience, so rendering a most valuable service to engineering science and promoting the general welfare of all who are interested in the practical use of electricity.

LONG DISTANCE TRANSMISSION OF POWER. [1]

BY CHARLES S. BRADLEY.

FOR the electrical transmission of power we have two general systems—the alternating and direct. The multiphase alternating was advertised extensively by the Lauffen-Frankfort plant in 1891. This pioneer plant was built by much sacrifice of time and money, and we owe gratitude and honor to these men whose indefatigable efforts accomplished the beginning of an art which is destined to revolutionize the social status of mankind. This plant proved conclusively that very high voltages could be successfully used and the insulation maintained. This is the whole thing in a nut-shell; the choice of this or that particular way of generating and using the energy is of secondary importance, and will vary with each situation; surprising as it may seem, the maintenance of the insulation was the least trouble in the operation of this plant. One of the greatest is the interference with the telegraph which belongs to the German Government, and when the German Government says "stop," it means stop (in Germany). The difficulty next in importance is the static induction, each wire, being so long and exposing so much surface, becomes a reservoir to hold electricity, and the generator must fill this reservoir on each impulse before it can deliver energy at the distant end. When the generator reverses the direction of current, as it does some 100 times per second in the alternating, this reservoir must be discharged and filled with electricity of opposite sign: that is, if the first impulse to a given wire is positive and fills its capacity with the positive electricity, the reverse impulse must discharge the positive and then fill the reservoir with negative electricity. This operation consumes but little power; it is an ebb and flow, as it were. The trouble, however, is that this idle current swinging back and forth occupies the carrying capacity of the generating apparatus; so much so, that I saw the fuses blown at Lauffen with no load of consequence at the Frankfort end. In damp weather the insulators become wet on the external surfaces, and this largely increases the capacity, which is more serious than the increased leakage. These difficulties vary with the length of the line and the amount of power transmitted, the surfaces being proportional to the length of line. The carrying capacity is proportional to the square of the diameter of the wire, while the static capacity is proportional to the surface, which is equivalent to being proportional to the diameter, so that the larger the amount of current transmitted the less proportional influence the static capacity has. These things must be determined by the engineer in each case. The Lauffen-Frankfort was an extreme case. First, the line was much longer than we shall expect for some time to come in practical work; second, the plant was intended for 300 h. p. and a rate of 40 periods per second. Owing to the static effects at 40, the rate had to be lowered to about 23 per second; this obliged them to run the dynamo at very much reduced speed, so that it was capable of only about 100 h. p., and this reduction increased the proportion effect of the static charge. In long distance transmission the lines should be carried on poles whenever it is possible, for the farther apart the conductors are, the less will be the inductive capacity; if placed under ground they will of necessity be near together. The placing in separate conduits to gain distance will not help, for the nearness of the earth is the equivalent of the nearness of the conductor of opposite sign. These things are only warnings, however, and slip out of sight with proper precaution. The multiphase alternating is the most pliable, adjustable system that has ever been conceived. Where the power is to be delivered in compact form the direct current offers some important advantages. We can get very high voltages by a battery of machines placed in series for the generator and motor stations. The placing of machines in series for power transmission was proposed by Mr. Edison in 1880 and Prof. Thomson in 1883. Each contributed some essential improvement, but it is evident that the enormously high voltages now contemplated were not then thought of. For the generator station I prefer compound wound machines; first, that the system may be self-regulating; second, that the series coil when a machine is thrown into action shall magnetize the field in the right direction; this also requires that the switch shall close the series coil first. The shunt coil would tend to reverse until the machine has attained E. M. F. enough to overcome the resistance of its own armature. In order that each machine shall be as far as possible independent of its neighbors, I prefer that it shall be short shunt, or in other words, the shunt coil be charged direct from the brushes of each machine. I would use the 500-volt machines, and of such ampere capacity as the size of the plant demanded, and belt them all from one shaft. The 500-volts have been found safe to life and the commutator works well. Now, we must protect the insulation of the windings; the end machines where the terminal voltage, say, reaches 20,000 volts may, in case of grounds, be subjected to the piercing strain of the entire electrical pressure. It is impracticable to insulate the windings of each machine to stand any such potential; therefore, we connect the windings of the machine at some point with the frame so that it may never be subjected to a strain greater than its own voltage; next each machine foundation is thoroughly insulated from earth, and, in case this insulation fails for any reason, the fuses of the line will be blown, thus protecting the whole structure. It is easy, however, to make this foundation insulation so perfect that no derangement will take place. For this, I have struck upon a cheap plan, which was not apparent at first. Having now provided for the insulation, we must next consider the safe handling of the machines. A moment's consideration of the electrical potential of each successive machine in the series will make it evident that the whole of each machine will attain the potential of its individual position; or, beginning at one end, each successive machine will be 500-volts above the preceding one. Now, like standing on a stool with glass legs, a man may be placed upon any one of these machines, and if he cannot touch any conductor to earth he is perfectly safe. We can use a wooden platform around and attached to the base of the machine, so that the man must cross it before he lays his hand on the metal part. Here, again, I want to point out how essential it is that the windings be in metallic connection with the frame for the safety of the man. It secures that no part of a machine shall exceed its own voltage, and, in case of a leakage in the foundation insulation, immediate detection. If this metallic connection were not provided and a leakage occurred in the foundation, you will readily see that it might be undetected, and a man touching the brushes and the frame would take a current through him of uncertain high voltage. At the motor station we use simple 500-volt shunt machines with the same precautions as at the generator station. Our power having been transmitted can now be converted into whatever may be demanded. If it is an electric system of distribution, we shall have the advantage of its being impossible for the high tension current to get into the system of distribution. If it is a large plant, the motor station may be subdivided into two or three parts, preferably in multiple arc, with the same potential on each. On very long lines I think the transmission must be done by direct current. To prophesy, although a temptation, is futile, for the lines of progress are not as one man would think, but as the multitude of surrounding circumstances determine.

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[1] Abstract of a Paper read before the National Electric Light Association, St. Louis, Mo., February 28 and March 1, 2, 1893.

THE INCANDESCENT LAMP FROM A COMMERCIAL STANDPOINT.[1]

BY CALVERT TOWNLEY.

In discussing the relation between the life and efficiency of different lamps, we may consider simply the characteristics of their burners. For convenience in discussion, we may divide the commercial lamp burners into three classes, viz:

1st. The untreated or natural burners used in the Edison lamps.

2d. The treated or flashed burners used in the Sawyer-Man, Thomson-Houston, Beacon, and a number of other lamps.

3d. What we may call the super-treated burners used in the new Westinghouse stopper lamps.

In all published tests of the life of burners there is shown to be a definite relation existing between the life of a carbon and the temperature at which it is burned, this relation remaining fixed for carbons of the same kind and varying only for carbons of different kinds. If we formulate this relation, it will assist us to determine what temperature of any kind of carbon may be expected to yield the best commercial results; that is to say, how much money it is desirable to spend on the maintenance of the carbon, and how much on the energy to heat it. The temperature of a burner is difficult of measurement. It will, therefore, be simpler, and quite as satisfactory, if we consider the relation between life and energy consumed, expressing the latter in watts.

By a series of experiments, extending over several years and covering tests of many thousand lamps, Mr. Frank Stuart Smith has found the relation between the life and efficiency of the Sawyer-Man carbons, and through his courtesy I am permitted to give you the results. The relation is expressed by a curve, where the axis of Y represents hours life, and the axis of X, watts per each candle of light produced.

The exact mathematical expression corresponding to this curve is somewhat complicated, but, as we are considering the question from a purely commercial standpoint, we may consider the curve between commercial limits, in which case we can express the relation within one-half of one per cent. by the formula,

$$L_{,} = 3.742\ E_{,}^{5.78} \qquad (1)$$

where L represents hours life and $E_{,}$ watts per candle.

During the past year a great many tests have been made by Mr. Smith with the super-treated carbons of the Westinghouse stopper lamps, and the relation between life and efficiency thereby found to exist is given by the equation,

$$L_{,,} = 5.44\ E_{,,}^{5.684} \qquad (2)$$

We note that this curve corresponds very closely in its general form to the curve of the treated burners, except that for a given efficiency the life of the super-treated burner is always longer. This is as it should be, inasmuch as the super-heated burner is, in fact, a treated burner which has been subjected to an additional process to render it more stable.

In 1888, Mr. John W. Howell presented a paper before this Association, in which he exhibited a curve stated to have been constructed from the results of a large number of tests made with the Edison or untreated burners. This curve is very similar to the curve of the treated and super-treated burners, and, considered between the same commercial limits, we can express it with equal accuracy by the formula.

$$L_{,,,} = 1.052\ E_{,,,}^{6.453} \qquad (3)$$

$L_{,,}$ and $E_{,,}$ having the same significance as before. For a given efficiency, we find the corresponding life of any class of carbon by tracing a perpendicular line until it intersects the proper curve, the corresponding life being found directly opposite the point of intersection horizontally. Thus, for an efficiency of 2.5 watts, we find the life of the untreated burner to be 400 hours, of the treated burner, 713 hours, and of the super-treated burner, 962 hours.

It is important to remember that these curves represent the results of laboratory tests, in which the E. M. F. is kept more nearly constant than is ordinarily possible under the conditions of central station lighting. Therefore, in order to obtain an expression which will represent commercial conditions, we must introduce the element of a variable E. M. F. Mr. Frank Stuart Smith has shown the relation between total energy consumed and the light emitted. This relation is represented by the equation.

$$I = \frac{W^2}{\sqrt{R^2 - W^2}} \qquad (4)$$

where I equals the total illuminating power expressed in candles and W equals watts, R being a constant, which depends for its value on the size and efficiency of the lamp; R is, in fact, the radius of the circle to which our tangent is referred. While the position of this curve varies with different lamps, the relation between the watts consumed and the light emitted remains unchanged through all tests.

By a comparison of laboratory and central station records a fair average assumption seems to be that, with proper attention to regulation, the commercial variation is equivalent to a constant excess voltage of 3 per cent. I have taken this a basis, and constructed commercial curves for the treated, the super-treated and untreated filaments. It is important to note the great effect that a comparatively small rise in E. M. F. has on the life of a lamp. Any neglect to maintain the best possible regulation, therefore, will result in an increased bill for lamp renewals entirely out of proportion to the variation in voltage itself.

We will not be far wrong, if we assume that the central station company has a market for all the lamp hours it can furnish during a certain portion of the day's run. With this assumption, let us formulate an expression for the profit in incandescent lighting; then we may determine what conditions will give this profit a maximum value. In the consideration of this matter I have taken as the unit of value one 16 candle lamp hour, assuming that what the public want is light, and that, other things being equal, they do not care whether much or little energy be expended to produce it.

With our unit of value illuminating power, therefore, our profit will obviously be the difference between the cost and selling price of a lamp hour multiplied by the number of lamp hours sold. We may, therefore, write the expression—

$$P = (v - c)\,\frac{S}{W}$$

where P equals profit, v selling price, c cost of lamp hour, S output of station in watt hours for the time for which our profit is estimated, and W watts required per lamp. Again, the cost of producing one lamp hour is clearly the proportionate cost of the lamp itself plus the cost of the energy consumed by it. We may, therefore, write—

$$c = \frac{l}{L} + \frac{l}{1000}W$$

where l equals cost of a lamp in cents, L its life in hours, and g cost of producing one kilowatt hour of energy. Substituting in this expression, from the formula of our commercial curves, the value of lamp life in terms of efficiency (bearing in mind that for a 16 candle power lamp $E = \frac{W}{16}$), and putting our expression for the value of c in place of c in the formula representing our profit, we have the equation—

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[1] Abstract of a Paper read before the National Electric Light Association, at St. Louis, Mo., February 28 to March 2, 1893.

$$P=\frac{VS}{W}-\frac{Sl\,(l+p)^{2b}}{Wa\left[\frac{W^2+256-256\,(l+p)^4}{256}\right]^{\frac{b}{2}}}-\frac{Sg}{1000}$$

where *a* and *b* stand, respectively, for the coefficients and exponents of the second terms of formulæ (1), (2) and (3).

I have taken the original cost of the lamps at, respectively, 35, 50 and 20 cents, the selling price of a lamp hour at, respectively, .5, .75 and 1 cent, and the cost of producing current at, respectively, 2, 3, 5 and 8 cents per kilowatt hour. By the courtesy of a considerable number of central station managers, who have furnished data concerning their respective plants, the average cost of this energy appears to vary between 3 and 7 cents. The only cases where 7 cents is exceeded are those in which fuel is a very expensive commodity and the station output is small. Where 3 cents is too high a very cheap fuel is used and a very large station operated. In assuming these values, I believe that we have covered as nearly as possible the conditions which actually exist, but it is quite easy to adapt our expression to any set of local conditions.

With the price of a lamp hour at one cent and the cost of generating current six cents per kilowatt hour, the best result we may expect from the treated filament lamp at 50 cents each is, with a 38 watt lamp, *i. e.*, 2.37 watts per candle, when our profit should be 16.6 cents per kilowatt hour. With the super-treated lamp at 20 cents, other conditions remaining the same, the best results are obtained with a 30 watt lamp and our profit should be 22 cents per kilowatt hour.

Two facts are especially prominent, namely: first, that although we have assumed strictly commercial conditions, the profits obtained are in excess of those actually made in practice, and, second, that the most economical lamp efficiencies are considerably higher than those of any commercial lamps now in use. It is interesting and very remarkable to note that in every case the profits fall off very rapidly for lamps of either too low or too high efficiency, the variation being more marked where current is dear and running expenses high. By putting these facts together, it is apparently clear that the long lived inefficient lamp is a very expensive article, and that too much weight has been given to the cost of lamp renewals, which shows prominently on the expense side of our ledger, while we have not paid enough attention to the great waste of energy due to low lamp efficiency. We note also that the most economical conditions call for, in the case of the untreated filaments, a life of between 250 and 525 hours; in the case of the treated filaments, a life of between 286 and 620 hours, and in the case of the super-treated filaments, a life of between 138 and 260 hours; the shorter life being in each case where both the cost and selling price of the lamp hour is high.

With a charge of three-quarters of a cent per lamp hour and five cents for the expense of generating one kilowatt hour, the use of a 50 watt lamp loses the operating company 1.05 cents for every kilowatt hour sold when using the 35 cent lamp with the untreated burner; 1.4 cents when using the 50 cent lamp with the treated burner, and 5.2 cents when using the 20 cent lamp with the super-treated burner, as compared with the profits which might be made if these various lamps were used at their respective best efficiencies. It is gratifying to find that the possibility of increased profits carries with it the implied possibility of reduced prices to the public and, therefore, a great demand for light, and greater success to the companies furnishing same, in competition with other illuminants.

I have said nothing in this paper in regard to fall in candle power, for the reason that, in both the treated and super-treated filaments, this fall is roughly proportional to the time the lamp has been burning, as compared to its total life; that is to say, if a filament has a life of 1,000 hours at a given efficiency, and during that time its fall in candle power is *A* per cent., if this filament is burned at an efficiency which will make its life 500 hours, its fall in candle power will still be approximately *A* per cent., so that our commercial results are not appreciably affected. For the untreated filament the fall in candle power is proportionately larger than in the other two filaments. Therefore, if we are making a comparison of total illuminating power per energy consumed, we must put the untreated filament on a somewhat lower scale than shown in the comparisons I have drawn.

POWER TRANSMISSION FOR CENTRAL STATIONS.[1]

By Dr. Louis Bell.

So far as distribution is concerned, we may divide electrical power transmission into three classes: First, the transmission of single units; second, the transmission of power to a centre of supply from which point it is to be distributed in various ways; third, supplying the power for lights and motors throughout the length of the transmission line. Each of these classes of work imposes conditions on the possible methods of transmission, and requires special consideration. In new plants hampered in no wise by existing stations, any one of these three cases may exist, perhaps the last two more frequently than the first. Where a single motor is to be employed, the problem is exceedingly straightforward. Where a new centre of distribution is to be organized, some complications are encountered, but not serious ones. Where power is to be scattered along the line, however, conditions arise which are not altogether easy of fulfillment and require a good deal of special care and skillful engineering.

To the working central station man, occupied with the details of a growing business, power transmission from a distant water fall, possesses a direct pecuniary interest. Sometimes a considerable saving may be effected by using part of the apparatus already on hand, for example, moving his arc machines and alternating lighting machines to the water power, if it is not too far away and transmitting power only for his power circuits or direct current lighting circuits. In a general investigation of the methods which may be employed, the case stands somewhat as follows, so far as the central station man is concerned:

First, if the distance over which he is to transmit power is moderate, he may use the ordinary direct current generator and motor, displace his engine with the motor and go ahead. But unfortunately, direct current machines of any considerable capacity are practically limited in voltage by the existence of a commutator, an article on which central station men in general waste no love. Dynamos and motors of large size cannot, individually, in the present state of the art be satisfactorily built for more than about 1,200 volts. Machines for greater voltage have very generally broken down in the experimental stage. For very small power units, arc machines might be employed, but for the purpose of the central station man, it is better to move his arc machines directly to the distant point. For voltages much in excess of that mentioned, we are then driven to the use of either direct current machines in series or alternating machines.

Where generators and motors are to be used as a single unit, direct current machines in series may be and are employed quite successfully, but as the voltage desirable on the line rises, the system contains a greater number of units and becomes more complicated and difficult to apply to central station practice. For instance, it is highly desirable for the successful operation of motors in series that they should be, practically, coupled to the same shaft, and should run under similar and uniform conditions, so while there are cases in which the method of coupling in series may be both convenient and cheap, it is in my opinion better general practice to employ alternating currents, after passing the ordinary limitations of direct currents.

Multi-phase currents, and by this I mean currents having more than one phase, are subject to the same general laws as any other alternating currents. Their most valuable peculiarity lies in the fact that for alternating currents of more than one phase, excellent motors can be built which will run at a steady speed, start under heavy load, and in general possess very much the same qualities as a well organized shunt motor of the ordinary kind. Incidentally, certain of the multi-phase systems, more especially the three-phase, enjoy the advantage of effecting something of a saving in copper, under favorable circumstances up to 25 per cent. from what would be required by a plain alternating current of the same nominal voltage. This saving is merely from the fact that in the three-phase line, the currents do not have their highest value at the same time, so that at any particular instant, two of the wires may serve as a sort of multiple return for the third. This advantage would be immediately thrown away, if for the three currents of different phase, three separate pairs of wires were employed, as it is thrown away where for two currents of different phase, two independent circuits are used.

The fundamental difference between single and multi-phase systems then, is mainly the adaptability of the latter for driving motors, and multi-phase are better than single phase motors principally in their ability to start under load, and somewhat larger output for the same weight.

Wherever, then, single motors are to be driven for operating, we will say, an electric light station, it is largely a matter of convenience whether we employ single or multi-phase motors. If the former can be conveniently started, they are fully competent to take care of the work, except in one special case which I will mention presently.

A single case in which multi-phase transmission becomes of great importance when the object is to work an existing central station, is in that case where railway circuits are to be supplied. A railway machine is subject to so great and violent variations of load, that if it were driven by an ordinary synchronous alternating motor, the latter would run great risk of being pulled out of phase by a sudden short circuit, when it would stop and stay stopped until deliberately started up again. The multi-phase motor can also be pulled out of phase, but not quite so easily, and it can be more readily started. We can, however, where railway currents are necessary, do much better than to drive the dynamos directly by motors of any kind. We can for this use start with the multi-phase current, and through the medium of a single machine, scarcely more complicated than an ordinary railway dynamo, transmute this multi-phase current into a direct 500-volt current of the ordinary sort. This very valuable result has been brought about through the ingenuity of my friend, Mr. C. S. Bradley, who invented the device a half dozen years ago. It has lain dormant, principally because there has been no special call for power transmission of any kind until recently, but to its thorough practicability, I can personally testify as a 100 kilowatt tri-phase direct current transformer which I recently tested, operated in the manner described, showed an efficiency of over 95 per cent at full load, stood sudden variations from no output up to 100 kilowatts and back again without even a wink at the brushes, and bore up under heavy overload without difficulty. Whenever, it is desirable to operate railway circuits by power derived from a distant source, these machines fulfill all practical requirements, and I believe are destined to come into very extensive use, and play an important part in the development of very long electric railroads.

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[1] Abstract of a Paper read before the National Electric Light Association, St. Louis, Mo., Feb. 28 to March 2, 1893.

Now, take up the case where a centre of distribution is to be fed, consisting, it may be, in part of an existing station and in part either of extensions and new circuits from this plant, or subsidiary centres of distribution having other districts of the same town. Here the problem becomes more complicated and it is almost impossible to lay down any general procedure. Each case is best handled by itself. We can, however, enunciate certain principles which will aid in the discussion of any definite case.

First, we can feed all existing railway circuits and extensions thereof very effectively and economically by use of the tri-phase direct current transformer just described.

Second, we can handle all direct current incandescent systems, whether two or three wire, by means of the same type of apparatus, the tri-phase direct current transformer.

Third, we can successfully operate any existing alternating incandescent circuits or any extensions thereof by feeding alternating current from the distant point directly into them through banks of transformers.

Fourth, if any new centres of distribution are to be made with circuits independent of those already in existence, we can operate these circuits very effectively for both lighting and motor service if both be necessary by employing multi-phase apparatus, and right here let me say that there is one widely-spread error which I desire most emphatically to contradict.

It has been asserted that incandescent lighting cannot be successfully done on multi-phase systems, especially tri-phase, since this system happens to have been most talked about. This statement is absolutely false, to my own personal experimental knowledge. Lamps can be successfully operated on systems of two, three or more phases as on an ordinary single phase circuit, provided equal pains be taken with the distribution of copper in the lines and the regulation of the voltage at the dynamos. If these conditions are observed, a two phase circuit with separate wires acts substantially as if it were fed from ordinary alternating dynamos. A tri-phase circuit gives a similar result, and if more phases were concerned, the same would be true. If the condition of constant voltage at the centre of distribution be fulfilled as it can be and must be for successful operation on any system whatever, two and three-phase incandescent lighting systems can and do work admirably. Furthermore, if we combine circuits, for example, if we use but three wires instead of six for three-phase systems, there is no exact equality of balance required between the lamps placed in different connections across these circuits. On the three-phase system, we would place lamps between each possible pair of the three wires, this arrangement gaining, as I before mentioned, in copper wire enough to compensate for the slight inconvenience in connecting three sets of lamps instead of one or two.

In taking up the condition I have just mentioned that of a new centre of distribution, I may briefly refer to the properties of multi-phase motors, which have been the subject of all sorts of curious misstatements, A multi-phase motor, I do not care whether it has two or more phases, should if properly built have very nearly the properties of a good shunt motor, and not far from the same efficiency. Incidentally, it has the advantage of having no commutator, and no necessity for any moving contacts. It starts under two, three or more times the running torque, just as a shunt motor does, and by virtue, if the torque is extreme, of a heavy starting current just as a shunt motor would. It comes rapidly up to a nearly fixed speed, and remains nearly at that speed under variations of load. If overloaded it stops, like any other motor, In addition, it has one great merit that shunt motors do not have, that of running at nearly constant speed independent both of load and moderate variations in voltage. It is on the whole less thin-skinned than a shunt motor. I have experimented with a considerable number of multi-phase motors of the induction type, to which I here especially refer, and although I have seen some terribly severe tests in the way of overload, I never yet saw any symptons of a burn-out. The efficiency of these machines should be and is at least within a per cent. or two of ordinary shunt motors. There are two important points in which multi-phase motors have been misrepresented, which I should like to mention. First, it has been stated of them that they take an enormous current when running light, and second, that they introduce a very large and most objectionable lag in the circuit, so that the apparent current on the line is much greater then the energy current. Such facts have doubtless been observed. Broadly speaking, they have been due to faulty design. A multi-phase motor will always take a somewhat larger current when running idle than the corresponding direct current motor, but it takes very little more energy running light as the phenomenon of lag then becomes noticeable, so that of the apparent current, only a portion represents energy. It is a perfectly simple matter to cut down the current required by a multiphase motor running idle to twenty or twenty-five per cent. of the full load current, still retaining a motor excellent in its other properties. As motors where power is sold by meter are usually cut-off when not needed, the whole question of this idle current sinks into insignificance. The same is true of the alleged lagging current, If a multi-phase motor (I speak with certainty at least regarding the three-phase) of 10 or 15 h. p. should show at full load more then 10 or 12 per cent. of lagging current, I should consider it to be badly designed.

Whatever the methods which may be employed, several serious questions must be confronted when one attempts to transmit power for supplying central station or any other apparatus. One of these which presents itself immediately, is whether or not in an alternating transmission it is advisable to use step-up and step-down transformers. The principal determining factor in this is cost. The higher voltage we can supply direct from the machine without increasing its cost considerably, the cheaper we can make the installations. Assuming 2,000 or 3,000 volts as the available potential obtained from the machine direct and then estimating the cost of a given installation, first using these machines, and second, using low voltage machines with step-up transformers, we find that at prices ordinarily charged for apparatus and copper, the two methods become of equal cost, at a distance of somewhere about seven or eight miles. Above these distances, the step-up transformers cheapen the plant, below it, they increase the expense. We can draw the line at no specified given distance for the general case but can very easily for any specific case. The amount of drop advisable in these long distance lines will depend, of course, principally upon the relative prices for copper and the apparatus necessary.

But for the central station man who desires to decrease his operating expenses by the employment of electrical transmission, the court of last resort is the balance sheet, and the fundamental question is, "Agreed that it is practicable, will it pay?" I can give no general answer to this question, for each problem necessarily must be considered by itself. I have, however, looked into the profit and loss probabilities of a large number of plants of all descriptions, and in a general way one can say that power transmission to a central station will, unless the cost of developing the water-power be very great, almost universally pay at distances of 10 to 12 miles or less. It will frequently pay up to 20 or 25 miles. Now and then, under extraordinary conditions (very expensive coal and very cheap water-power) up to 40 or possibly even 50 miles. In using alternating currents at these long distances, one naturally fears the effects of inductance in the lines and of static capacity. In very long lines, operated at high frequency, these difficulties may rise to formidable magnitudes. Knowing the dimensions of the line, the frequency and the currents, it is, however, possible to calculate the effects of these disturbing elements with great accuracy. From these calculations I feel safe in saying that within the distance mentioned, inductance and static capacity constitute no serious obstacle to success, if the frequency employed be moderate.

Throughout this discussion I have taken the position that no one method of procedure is applicable to all cases. Personally, I am decidedly eclectic in my taste, believing that it is better to put in for each individual case such apparatus, as on the whole proves to be cheapest and best rather than to advocate, on any fine drawn theories, methods which might be applied to the perfectly general case of transmission of power. It is the concrete rather than the abstract that we have to consider when proposing apparatus on which the success of large commercial affairs depends, and although some methods are better than others, it is well to remember that while the electrical pharmacopæa may have its calomel and paregoric, it contains no elixir of life.

TRANSFER OF A NEWARK ELECTRIC LINE.

President Barr of the New Jersey Traction Company, John D. Crimmins, Bernard Shanley, and others interested in the big railroad deal in New Jersey, had a conference in Newark recently and signed the agreement necessary for the transfer of the Newark road. It is said that the new managers assume all existing obligations and respect all existing contracts, and are to pay to stockholders a fixed dividend of 5 per cent. per annum, with a pro rata share of the profits on a capital basis. There are 1,800 shares held in Newark. It was stated openly that the Pennsylvania Railroad was interested in the deal.

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Asso. Editor: George B. Muldaur.

New England Editor and Manager, A. C. Shaw, Room 70—620 Atlantic Avenue Boston, Mass.
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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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THE ST. LOUIS CONVENTION AND ITS OUTLOOK.

THE St. Louis Convention has come and gone, and the National Electric Light Association has added another to its long list of successes. The attendance was good, the papers were excellent, the discussions were not too rambling, and the hospitality was as warm as the Southern heart could make it. As usual, a careful selection of officers was made. We had expected to see Mr. C. H. Wilmerding the choice for President, but all his admirable qualities were obscured by the unsupported belief that he might promote a policy favorable to the General Electric Co.; and the intense feeling on this subject led to the choice of Judge Armstong, who is understood not to be the wearer of anybody's collar. Since the honor has fallen to the East, we think that Mr. A. J. De Camp was well worthy of it. He is an old officer of the Association, represents large investments with credit, has always taken an active interest in the welfare of the Association, and has entertained it royally. We say all this without prejudice to Judge Armstrong, who is certainly one of the most brilliant and progressive of the younger men in the body, and who sees the deeper questions involved in the industry with which he is connected. His administration should prove highly prosperous and should lead the Association to a higher plane of influence and usefulness than it has ever occupied before.

It was the general hope that an earnest discussion might be had of the lamp situation. Town meetings cannot break Supreme Court decisions, but public opinion has been known to govern the enforcement of legal decrees and to shape not merely the policy of corporations but the acts of governments. Said President Cleveland in his inaugural address on Saturday last :—

> "The existence of immense aggregations of kindred enterprises and combinations of business interests, formed for the purpose of limiting production and fixing prices, is inconsistent with the fair field which ought to be opened to every independent activity. Legitimate strife in business should not be superseded by an enforced concession to the demands of combinations that have the power to destroy, nor should the people to be served lose the benefit of cheapness which usually results from wholesome competition. These aggregations and combinations frequently constitute conspiracies against the interests of the people, and in all their phases they are unnatural and opposed to our American sense of fairness. To the extent that they can be reached and restrained by Federal power, the general government should relieve our citizens from their interference and exactions."

That is exactly the feeling which a great many people in the electrical field and outside of it have about the General Electric Co., and it was uttered by not a few censorious tongues, in less measured phrase, at St. Louis. When the topic came up incidentally in the Convention, it provoked personalities, and the discussion, leading nowhither, was soon checked. It is absurd to suppose that such debate can do any good, but it had at least the merit of showing how strong and fierce is the undercurrent of opposition to the restrictive and monopolistic designs with which the General Electric Co. has been credited. That Company has valuable rights, and should enjoy them to the full; but there are other rights, and these will be stoutly protected against any assault it may make. To say that the antagonistic sentiment towards the Company, due to dislike and distrust, is so intense as to keep it on its good behavior should it intend to go wrong, is simply to state the truth. In the long run it may be shown that the Company has been unfairly prejudged. We sincerely hope so, for its own sake. The cares and perplexities resting on its able management are of no mean order, but they can be greatly reduced in the adoption and enunciation of liberal plans, to the approval and support of which all honest and true men will rally.

ELECTRICAL DEVELOPMENT IN ST. LOUIS.

Probably every visitor to St. Louis last week was impressed with the electrical activity of the city, and the great popularity of the trolley system of traction. The city has probably something under 600,000 inhabitants, yet the street railways, nearly all electric, collected 100,000,000 fares last year, showing an average of not less than 165 trips per person per year—a very high figure. There are about 300 miles of car line, and 50 more are building, and one of the trolley lines runs 20 miles out from the power house. Such progress does the city infinite credit, and we can say from practical experience that we wish New York had as good travel facilities as St. Louis has, thanks to electricity. The line construction and central station work inspected was also very good, reflecting most favorably on the administrative ability of Mr. Ayer and other managers operating plants in the city. It is this opportunity to see what others are doing that makes the conventions so valuable to the members who attend. Membership without participation in the proceedings is worth little compared with membership which wants something more than the reading of reports in electrical journals and the volumes of transactions. In this light, St. Louis is one of the finest object lessons that could be had.

UNDERGROUND CONDUITS AND CONDUCTORS AND THE EXPERIENCES OF ELECTRIC LIGHTING COMPANIES OF NEW YORK CITY.[1]

BY WM. H. BROWN

THOSE who are intimately acquainted with the histories of the electric lighting companies of New York City may be pardoned if they believe that the experiences undergone by these companies have been unique, and that they afford to companies elsewhere opportunities for beneficial consideration.

At the risk of presenting some incidents having the aroma of antiquity, or being tedious by the recital of what may perhaps now be considered well-worn tales, attention is invited to a statement as brief as possible of the story of electric lighting in New York City from the beginning to the present time.

In the years 1880 and 1881, but twelve or thirteen years ago, two companies began in New York City the business of distributing electric current from central stations for public and private illumination, the one using the Brush, the other the United States system of arc lighting.

In addition to the imperfect apparatus at their disposal other difficulties, the best medium then obtainable for the transmission of current of high potential was bare wire. With the progress that took place, however in the improvement of the conductor, improvements in the apparatus and appliances also appeared.

The extension of the use of electric illumination was not so rapid or so widespread as to call for many wires or very large poles. The operators of the company had not had such strong pecuniary inducements as to justify them in being very enthusiastic in looking to the possibilities of the future. They felt justified in restricting their efforts to satisfy such demands as were made upon them, and whenever a customer was obtained beyond the limits of the wires already erected the lines were extended with the least possible expense. The poles used were ordinarily 6 to 8 inches in diameter at the base, and 20 to 25 feet high, provided usually with a four-pin cross arm. A few of these poles have remained and are in existence at the present day.

In the year 1884 manufacturers of other apparatus saw in New York City a field of profit and advancement for their machinery. New York was the largest and richest city of the United States; the companies then doing business in that city were actually on the verge of paying dividends; and it could not be considered proper in the interests of the public that they should continue to have a monopoly. The result was that in the year 1884 franchises were granted to no less than six other companies, all of them primarily intended for arc lighting. Some of these companies, taking note of the numerous poles that were in existence for the telegraph, telephone, police and fire department service, deemed it uneconomical to erect poles for their own wires, but arrranged with those having charge of such poles for the attachment of the electric light conductors on these existing poles. Some of the companies erected in that year did not make rapid progress, and the increase of poles and wires for electric lighting was not materially appreciable until 1888.

In 1884 a bill was passed in the Legislature directing that the wires be removed from the streets before the first day of November, 1885, but it provided no means to insure their removal, nor penalties for non-removal. The Legislature of 1885 having found that the previous enactment had accomplished nothing passed another act which provided "that if no suitable plan should be proposed for placing the said wires underground, it should be the duty of the said Board of Commissioners to be caused to be devised and made ready for use such a general plan as would meet the requirements of the said Acts of 1884-5, and that the said Board should have full authority to compel all companies to use the subways prepared." Under this act the Subway Commissioners who had not been provided by the act with funds wherewith to carry out the object named in the act, deemed it wise, in order to carry out the purpose of the enactment, to make a contract with some company to build the subways, and did make such contract in 1886. Persons interested in the telephone company realized that the purpose of this act would inevitably be carried out; and as the interest of that company in the fulfillment of such purpose would be affected to a greater extent than any other, except possibly the telegraph company, they deemed it prudent to become interested in the company with whom the Subway Commissioners had made the contract for the construction of subways.

In 1888 began the introduction of the alternating system of incandescent lighting and four companies began a spirited effort for the introduction of incandescent lighting with the result of contracting for upwards of 60,000 lights within less than a year. This caused a considerable increase of wires. The wires were strung principally upon the poles previously in use. Comparatively few new poles were erected until in the latter part of 1888. The Board of Electrical Control, recognizing the increase of electric lighting, formulated rules for the extension of that business by means of overhead construction, and in order to provide the best possible overhead construction, prescribed certain requirements on which, with the immediate supervision of the Board of Electrical Control, what has probably been the finest line in the world was erected. It was considered an ideal line. It consisted of poles 85 feet high, 16 to 20 inches in diameter at the base, and not less than eight inches at the top.

During 1888 the companies having aerial lines in upper Broadway were directed to place cables in the conduits which had been prepared in that street and to remove their overhead construction, but they declared vigorously that it would be impossible to operate currents of high tension underground. The courts declared that the law gave to the Board of Electrical Control the power and the right to decide whether the subways were fit and proper for the purpose, and ruled that the companies must comply with the law and occupy their subways with their cables and remove their overhead construction.

In August, 1888, the first effort was made to use the electric light subways on Broadway from 14th to 135th streets. The Subway Company had invited the companies to make the experiment of operating high tension current underground and offered the use of the subways without rental for the experiment. The first cable was placed for arc service and consisted of eight conductors, insulated from each other and enclosed in lead armor. The experiment with this was not successful. The cable did not meet the requirement of the Board of Electrical Control of an insulation resistance of fifteen megohms per mile for each 100 volts for each conductor. This result seemed to verify the claims of the companies that arc lights could not be served from underground conductors under the conditions imposed and existing. The opposite view was maintained, however, by the Board of Electrical Control and its contractor company, and the courts having held that the law accepted no other decision than the opinion of the Board, the companies were threatened with the removal of their aerial wires in the localities provided with subways, whether they placed cables in the conduits or not.

The year of 1890 brought a new Mayor and President of the Board of Electrical Control. He immediately promulgated the order that within ninety days the wires must be removed by the companies from streets provided with subways or he would exercise the right given by the law to have them removed by the city, and as the order was not complied with, on the 5th day of April, 1889, the authorities began the cutting down of the electric light aerial lines on Broadway and Sixth avenue, where the subways had been provided.

Concert of action between the authorities and the companies; careful deliberation of the probable requirements and the energy which makes haste slowly but correctly would not have produced, it is true, the removal of the overhead line to the extent that was accomplished within practically two years; but also it would not have produced the extraordinary expenditure of money both by the Subway Company and the electric lighting companies, nor the loss of business and disturbance that occurred to the companies; but it is fair to presume that a somewhat different condition of the subway situations and of the electric light companies would have been effected with material benefits to all financially interested.

Mr. Browne then gave a number of statistics of underground work. These have already been covered in the recent articles by Mr. William Maver, Jr., in THE ELECTRICAL ENGINEER.

Nearly all the current for the high tension arc and incandescent service transmitted in the city of New York below the Harlem river is conveyed by underground cables. Above the Harlem river the Board of Electrical Control allows the construction of aerial lines, no subways having been built in that section of the city. Below the Harlem River no over-head wires are permitted to be erected and few of those that were in existence remain. It is probable that before the end of this year scarcely any will be in existence. The penalties endured by the companies for their opposition to the subways have been severe and drastic. The expense imposed upon them in their effort to take care of their business and meet the requirements of transferring their systems from overhead to underground has been enormous and burdensome. The expense for rentals, due in a large measure to the amount of subways constructed and not occupied, continues and seems likely to continue to be an enormous tax. Those expenses and burdens have tended and are likely to tend further in the future to confine the operations of the companies to territory contiguous to their generating stations, and may also tend to avoid the fierce competition which existed during the days of aerial transmission, and which lowered price to a point below remunerative rates.

If the subway situation in New York City was not such as it is, and it is such from the causes above suggested, there seems no no reason to doubt, in the light of the experience possessed by all conversant with the situation, that fully as satisfactory accommodations and results, could be accomplished at not exceeding 25 per cent. of what it has cost, and with corresponding beneficial conditions, which would prove, at least, not unremunerative to all interests affected.

May it not be concluded, in view of the experiences in New York City, that all aerial conductors are necessarily transitory, particularly in our large cities? Is it not advisable for controllers and managers of companies in such places to recognize that condition and endeavor to avoid the experiences of New York Companies by planning deliberately the procurement of the right to themselves to build and operate their own subways and further to utilize the experiences of New York to avoid the expensive mistakes there made and to place their business on a stable footing and in a position where they may have immunity from injurious and cheap competition and secure service to their customers free from the interruption belonging to aerial transmission? If the above recital of causes and effects, experiences and results, in New York City, will tend to prepare the way to avoid, to other companies, the experiences of those in New York City, the relator will feel as rewarded for his effort, as he is appreciative of the compliment implied by the invitation of our worthy President which has afforded the opportunity to offer it for your consideration.

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[1] Abstract of a Paper read before the National Electric Light Association, St. Louis, Mo., Feb. 28-March 2, 1893.

THERMAL STORAGE FOR CENTRAL STATIONS.[1]

BY PROF. GEO. FORBES, F. R. S.

When asked to give you a paper on some electric lighting subject, it seemed to me that that I could not choose a better one than "Thermal Storage for Central Stations," which has had so much attention directed to it lately in England. It has long been evident that storage of some kind might lead to great economy in central station work. The reason of this is that the demand for light has in most cities a maximum for only two or three hours of the day. Not only do we require to have plant lying idle all the rest of the day, but the expense of working for these few hours is increased by its temporary character. This loss of economy has occurred both in engines and boilers. Underloaded engines are very inefficient and use up a lot of coal. This effect is, however, gotten over in all important central stations by having at least a few engines of small power to carry the day load. We are thus able to have engines in use always working at their most economical load that is, near full load.

The other loss in economy comes from the boilers which have to be fired up and heated only for a few hours' work and then banked or else allowed to cool down. This loss cannot be overcome by working the ordinary plant in any special manner. At the Kensington Station in London, where the engines are always working at an economical load, five pounds of coal are used per electrical horse power per hour, whereas in tests of 26 hours duration, made on the same plant with all the boilers doing full work, only three and a half pounds of coal were required for the same duty. If then we could have storage of any kind by which power is absorbed at times of light load and given off at times of heavy load, we should save one and a half pounds of coal per horse-power per hour. Many people have thought that storage batteries would overcome this trouble. It does so, but at an enormous capital expenditure on storage batteries, with a loss of twenty per cent. in the energy given to the batteries, and with a depreciation account which no one would put at a less figure than twelve per cent. per annum.

I have previously proposed that in a hilly country the boilers and engines should be working all the twenty-four hours, at the rate of the average demand, and they should be used to pump water through a pipe to a high reservoir at least five hundred feet above the pumping station. At the lower end of the pipe turbines are placed driving dynamos. During the day-time the reservoir is being filled and in the evening it is being emptied. This produces a saving in boilers and the substitution of cheap turbines and a small number of efficient pumping engines for a large number of less efficient engines to drive dynamos. It also reduces the coal consumption from five pounds to three pounds per horse-power per hour. In a paper read last year before the British Association for the Advancement of Science, I showed that this plan could easily be adopted in Edinburgh, in Scotland, the saving in capital and annual expenses being both very large. But it is not every city that has these advantages, and I wish now to introduce to your notice the excellent scheme which has been invented by Mr. Druitt Halpin of England.

He proposes to put up boilers only of the average capacity and to work them day and night. At times of light load the steam is carried through pipes into large iron reservoirs of cheap construction, and is used to heat up the water in these reservoirs to a high temperature and pressure. When the heavy demand comes on in the evening, steam is drawn from these reservoirs. The losses of heat from radiation from the reservoirs can be made very small indeed, with proper lagging; in fact, quite imperceptible.

This is the general scheme of Mr. Halpin's plan. But it has two advantages which are not so apparent at first sight. One is the purity of the water supplied to the boilers. Mr. Halpin pumps feed water into the hot reservoirs where impurities are precipitated in a place where they can do no harm. The boilers, on the other hand, are fed from this pure water in the reservoirs. The other incidental advantage of the system is that priming in the boilers does not cause any inconvenience, as the steam is all supplied to the engines from the reservoirs. Now it has been found from the experience with the water-tube boilers which are so much used in this country that only three pounds of coal per hour can be burned per square foot of heating surface on account of excessive priming, instead of the six pounds per square foot which we can use with the Cornish or Lancashire boilers, and which might be used with water-tube boilers if priming were no objection. Thus it appears that the adoption of Mr. Halpin's system not only reduces the number of boilers that we require, but also doubles the capacity of each boiler.

Mr. Halpin has worked out the relative cost of supplying machinery to the central station of Berlin (1) without any storage (2) with storage batteries, and (3) with thermal storage. He first selected this station because the output at each hour of the day all through the year was published before any other central station had published similar data. In this system there are four central stations, giving off about ten thousand electrical horse power.

The load at different times of the day is such as to lead to the following data:

Maximum load	7,500 kilowatts.
Mean load	2,030 "
Excess of max. above mean	5,080 "
Duration of ditto,	7.5 hours.

Now Mr. Halpin claims that he can replace 22 boilers for working in the ordinary way by five boilers and 92 of his storage cylinders, which are cheap to construct and have necessarily a small evaporation. His claim, which I must admit seems to be quite well founded, is that while laying out somewhat more capital on his plan, he gets a very large return for the extra capital spent. He sums up the cost of the thermal storage system as follows:

5 Babcock & Wilcox Boilers,	$27,050.00
Boiler House,	9,500.00
Chimney,	4,850.00
Cylinder House,	33,300.00
92 Cylinders,	184,000.00
Total,	258,700 00

and he puts the cost under the existing system at $182,700.00.

Now if we charge 10 per cent. to annual depreciation of boilers and only five per cent. on the iron cylinders, which really seems a very fair value, then the annual interest and depreciation comes out almost the same for both systems, thus:

Existing System.	
5 per cent, on $182,700.00 capital,	$ 9,135.00
10 " " " 117.850 boilers,	11,785.00
4 " " " 64,850.00 buildings,	2,600.00
Total,	$23,520.00
Thermal Storage.	
5 per cent on 258,700.00 capital,	$12,935.00
10 " " " 27,050 boilers	2,705,00
4 " " " 47,050.00 buildings,	1,900.00
5 " " " 18,400 cylinders.	9,200.00
Total,	$26,740.00

Annual charges against thermal storage, $3,220.00, but the annual saving in coal is, in this special case, 7,000 tons, besides the saving in ash removals and firing. Mr. Halpin thus obtains figures, giving an annual saving of $36,530.00, to pay interest on extra capital of $75,000.00, with coal about $5.00 per ton.

Now the only kind of storage against which Mr. Halpin has to compete, when high land is not available for utilizing water storage, is the storage battery; and from his figures, which seem fair to me, the extra capital required is $732,200.00, and the total annual extra cost, $110,750 00, which shows a great advantage in thermal storage.

I consider that all these figures are very conservative, and that in these days when we are learning to realize the importance of cutting down working expenses in central stations, this system must necessarily occupy an important place. But it is of peculiar interest to me, owing to its applicability to a kind of work to which I have devoted a large part of my time in the last seven or eight years. I refer to the burning of the house refuse and garbage in our cities. The furnaces in which this cremation is accomplished are generally called "Destructors". It has been one of the great objects before me of late years to have this title abolished, and to justify their being called "Utilizers". The improvements which we have introduced in the methods of burning refuse are so great that I can now undertake to produce the following results:—

Taking the ordinary house refuse, ashes, coal, wood, paper, old books, vegetables, bones and scraps, crockery, tin cans, iron posts, bottles, and adding thereto occasionally dead cats and dogs, infected mattresses and condemned meat, I can throw the whole of these, without sorting, upon the furnace, and without producing any offensive odors or dust I can raise the temperature of the gases where they reach the boilers to over 2000 degrees Fahrenheit. From my data as to the amount collected in different houses in England per head of the population, I find that from the house refuse of any town I can supply steam enough to generate electric light at the rate of one 16 candle-power lamp per head of the population for two hours every night of the year. By doing this I am saving the municipality from $10,000 to $20,000 per annum per 100,000 inhabitants for the cost of removal of house refuse. I am preventing these objectionable materials from being dumped in the outskirts of the city, where building operations will soon commence, or in the neigboring harbors or lakes, either of which plan is a nuisance and unhealthy. The only resulting material is a clinker, which can be broken up, and which when mixed with cement makes admirable concrete or artificial stone for paving, while by itself it makes excellent foundations for roads.

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[1] Read before the National Electric Light Association, St. Louis, Feb. 28-March 2, 1893.

Now these enomorous advantages, of the truth of which we have ample proof from a practice extending over nearly twenty years in England, can be worked at full economy only when the burning of refuse is quite continuous and uniform. To do this we must have storage of some kind. In hilly countries the plan I have advocated of water storage is generally available, and is very economical. In all other cases thermal storage is far and away the most economical mode of working, and in this line alone, if in no other, I have always said, from the first moment I knew of Mr. Halpin's invention, that we have here the last item which was wanting in order to do away with the barbarous methods generally adopted for getting rid of house refuse, and at the same time utilizing that refuse in a manner that will confer material benefits on all the inhabitants of a great town, and pecuniary advantage on those who undertake the work.

PROCEEDINGS OF THE SIXTEENTH MEETING OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

FEBRUARY 28, 1892.—MORNING SESSION.

THE meeting was called to order in the Telephone Building by **PRESIDENT AYER**, who introduced Mayor Noonan, of St. Louis, who welcomed the Association to the city.

PRESIDENT AYER then delivered the following address:

PRESIDENT AYER'S ADDRESS.

At this, our sixteenth convention, it gives me much pleasure to receive you in a city which can display such an appreciation of the work in which we are engaged; to welcome you in my home and be able to present to you the attractive programme that has been prepared.

Since the first meeting in 1885 at our sister city by the lakes, we have spread upon our records evidence of the wonderful progress of the great industry we represent, and while as measured by time the years are few, the progress is marvelous. No art, no industry, no science can compare with it; and in no more forcible manner can it be represented than by stating that there is more capital invested in St. Louis in the application of electricity to-day than the sum total of investment throughout the United States for the production of apparatus and its use when this Association was born. These are facts well known, yet hardly realized by those of us who are engaged in promoting this remarkable development. In St. Louis we have enstalled 266 dynamos in central stations and various private plants, supplying current to 185,000 incandescent and 5,330 arc lamps; a total of 1,800 h. p. capacity of generators, supplying 660 motors for operating almost every character of machinery, and 8,240 h. p. in generators, operating 1,126 street car motors, over 160 miles of road; and the roads under construction, to be completed within the year, will add 8,000 h. p. in capacity and 96 miles of road. This will make a total generating capacity of 30,000 h. p.

There are nearly sixty square miles of territory supplied with arc and incandescent lights, and which is crossed and re-crossed with electric roads. The changing from steam and cable to electricity for motive power has transformed a bankrupt road into a most valuable property, and successful cable roads are to be changed at much expense to electric, that they may be more successful. This exposition of the development of this industry is what St. Louis has to offer for your inspection.

Since our last meeting much has transpired of interest to the members of the Association. Important developments have been announced from time to time through the press, as the result of the work of inventors, and many valuable items of detail have been brought out to add to the efficiency and satisfactory working of existing apparatus. The commercial development, however, has been confined to improvements in well-known apparatus and not to radical departures in character of generators as many were led to expect a year ago. More light will doubtless be given us in this direction through some of the papers we will be favored with, but there seems to be little likelihood of the introduction of new methods soon which will affect the quality of investments in existing apparatus, though there is reason to expect in the very near future that which will likely solve the problem of long distance transmission in a satisfactory manner. The much desired power motor for simple alternating circuits we are still anxiously looking for, and for some applications such motors as are known to be practical should be produced.

The recent patent decisions have introduced a new condition to many, brought anxiety and trouble to some and satisfaction to others. To those of us who were lulled into security by the tedious delays of the courts and the persuasive arguments of our friend, the salesman, who had so many advantages to offer, comes anxiety. To those of us who have only recently entered the field, and who heard very little of claims for "foundation patents," it is a new condition we can hardly realize, and we doubt its reality; and we are strengthened in our doubt by those who do not want it so. To those of us who consider carefully and believe in the ultimate establishment of the inventors' claims and rights, and who gave evidence in support of this faith by paying, in addition to a fair market price for the apparatus, an additional sum for the right to use it, and who have waited many years to receive the protection we paid for, comes the following satisfaction:

That such a condition as exists to-day can be brought about calls for prompt action, that the rights of the people may be better protected. That the inventor can be so long deprived of his rights that many are led to believe by the delay that he has none, and to such an extent that millions are invested in developing a business made possible by his invention, without regard to his claims, is clear evidence of the need of reform in our laws which will provide adequate protection for the investor, as well as the inventor; and we earnestly recommend some action on the part of this association, that our properties which have been so long regarded with distrust and suspicion by the financial world may not have added to their burdens the question of their right to use devices which are vital to their success; and to so place the station manager that he must not add to his other essential qualifications that of being able to divine what the courts may do in the far future. At previous conventions this topic has been considered and efforts made to have Congress take such action as would give relief. Work in this direction should be taken up again by this body and vigorously pushed to completion.

I note with much pleasure that since our most interesting and delightful visit to Montreal, most rapid advancements in electrical interests have followed, and that the Canadian Electrical Society has at a recent meeting given much evidence of remarkable growth. That, with the greatly increased business of our electrical manufacturers, notwithstanding the protection wall over which their "heavy" products have to be lifted, indicates that our time was well spent; that there was developed a friendlier feeling and closer intimacy, besides giving an impetus to electrical development for which they seemed to have been waiting. I believe our visit has done much to hasten the time when there will be no wall between one country and one people.

The preparation for the World's Fair is rapidly nearing completion, and in a few short weeks there will be opened to the visitor one of the most magnificent achievements of modern times—an engineering and architectural wonder. In no particular is it more remarkable than in the department of electricity. This in its ramification permeates all departments and will make possible most marvelously beautiful effects, as well as prove the most useful of servants. Too much praise cannot be awarded those who have labored to produce this most complete exposition of the development of the science in all its forms.

The American Institute of Electrical Engineers is doing much to assist in the arrangements for a fitting meeting of the electricians of the world, and our committee will present a report which, with the information received from a representative of the World's Fair, will enable us to act in the best manner to show the national and patriotic character of our organization.

In the past year much work has been accomplished by our secretary, and the showing for the year will, I feel, be very satisfactory when his report is read. Three volumes of the association's proceedings have been edited, published and delivered to members within the year, bringing this work down to date. Because of the accumulation and the large amount of matter contained in each volume this has been no small task, and the creditable results obtained in the handsome volumes, together with the thorough manner in which the office has been conducted, make it but a simple act of justice that I express my thanks and commendation at this time.

The interest in the proceedings of the convention evinced by the educational institutions throughout the country is one of the encouraging signs of the times, and justifies the statement (which is evidenced in many other ways) that the power and influence of the association are extending. The increase of membership is flattering. With this condition existing there will come up for your final consideration the question relative to the reduction of dues. While present conditions indicate that we can with safety reduce our dues, and possibly increase the membership beyond its natural growth under the present rate, yet there is much work which can be carried out to the benefit of the association which would have to be neglected if our revenue is reduced. The dues at present are hardly a burden, and a balance on the right side of the ledger is essential to the prosperity of any institution. While a change in the dues would not affect our treasury for more than a year, during which there will be extra expenses on account of the meeting which will necessarily have to be held in Chicago, I do not think it wise to reduce them at present. This question I trust will receive due consideration before action is taken.

From the beginning until to-day every producer and operator in the electrical field has had before him the serious problem of how to get men sufficiently skilled to execute in a satisfactory manner the duties assigned them. Undoubtedly this business has attracted in all departments the most ambitious elements from other lines of work, but as we can all testify, their education in the new field has been enormously expensive to their employers. But the future outlook is promising. While within the past three years this army has more than doubled, and the new element had little or no previous training or knowledge of the work, yet there have been established more rapidly than ever clubs, societies, trade guilds and labor organizations, with the principal avowed object of self-education. Their objects and efforts in this line are to be commended, and form a pertinent topic for this body to consider. In St. Louis we have among societies of this class, an organization known as the Electrical Exchange, composed principally of contractors whose particular business is to do electrical construction required in all modern buildings. Their prime object in organizing was, that the execution of this work might be confined to those who were responsible and maintained regular establishments. Their endeavor is to so execute the work entrusted to them that they may command the respect and confidence of the central station manager, owner, architect and builder. To this end they meet for discussing improved methods, and such other matter as may be suggested and calculated to be of mutual benefit. Insurance inspectors, supply houses and central station companies are eligible to membership. In contact with them we find them ever ready to coöperate with us in any movement to improve the service and increase the satisfaction of our customers; and since their organization a much better feeling has been established and the quality of work greatly improved.

Within the past year has been organized the National Association of Electrical Workers, with headquarters in this city, and having branches in many towns and cities. This organization is largely composed of linemen, though it expects to embrace in its membership electrical artisans or workers in every department. Their principal object is, as stated, in the first number of their journal, is to band themselves together for mutual education and improvement; to establish rooms and provide instructors, and adopt such other methods as may improve the standard of electrical labor. This organization is capable of accomplishing a vast amount of good, if maintained on the high plane outlined. If the effort is earnest and honest we can all lend then a helping hand and will do it gladly. The wage question will never be an element to make a breach when the rank and file of electrical workers have mastered their business. But until that time arrives those who are among them as leaders should keep in mind that satisfactory work, performed in a conscientious manner is the first essential to pleasant mutual relations between the employer and the employed, as well as the strongest lever to raise wages that can be produced.

Thoughtful care on the part of the manager must be given that the man who climbs the pole to clear a ground or close a circuit, in the sleet and rain, and all others as well, be protected by all safeguards in the way of instructions and appliances that can be suggested. The engineer, the dynamo tender, the lamp trimmer, all must be encouraged in their efforts to improve in knowledge, by active coöperation on the part of the management. A close acquaintance with our employés is an essential to a full appreciation of their services. Many acts of heroism are performed by the lineman or the dynamo tender, in order that the service may not be interrupted, and that, many times, without a passing mention. We can shake out the crosses and clear the grounds by a closer acquaintance with our men and their work.

During the year that has passed, death has claimed an unusual number whose names have been prominently identified with the active promotion, development and application of electricity in its various branches. Those particularly interested in the department devoted to telegraphy were, Cyrus W. Field, Wilson G. Hunt, F. N. Gisborne, Jay Gould and Norvin Green. In electric lighting and railways, C. J. Van Depoele, E. T. Lynch, Jr., M. M. Slattery, and in Europe, Werner von Siemens. In this list are the names of those who have borne much of the heat and burden of the day and were among the few pioneers who hewed the part and assisted to broaden the road, by overcoming difficulties which we, who find it so comparatively smooth to-day, little appreciate.

To our guests who have assembled with us and honored us by their presence, and who will further honor and instruct us with their words of wisdom, I want to express our thanks; and I trust that the members will by their presence at the different sessions demonstrate the sincerity of this expression on their behalf.

At the conclusion of his address, the president declared the Sixteenth Convention of the National Electric Light Association formally opened, and the paper by Mr. A. D. Adams on "Wrought versus Cast Iron for Field Magnet Frames" was then read.[1]

There was no discussion on this paper. The secretary made several announcements, and read letters of regret, as well as a number of invitations extending courtesies to the Association.

An invitation to hold the next meeting of the Association in Omaha, Neb., was read from Hon. G. P. Bemis, Mayor of Omaha.

Mr. E. A. Armstrong then read the report of the committee on the World's Columbian Fair, the chairman B. E. Sunny not being present.

REPORT OF THE WORLD'S COLUMBIAN EXPOSITION COMMITTEE.

The Paris Exposition of 1881 was lighted in part by 1,383 arc lights, and was the first arc-lighted exposition. The Louisville Exposition of 1882 was lighted by 5,000 incandescent lights of 15 c. p. each, and was the first use of incandescents for exposition lighting. The New Orleans Exposition was lighted by both arc and incandescent.

The Paris Exposition of 1889 made the largest use of electricity up to that time. There were for public lighting service 1,093 arcs and 8,837 incandescents. For private lighting there were used 623 arcs and 4,010 incandescents. The total of the service installation aggregated 3,125 h. p. capacity, and, with small installations, the grand aggregate capacity reached nearly nearly 4,000 h. p. There was practically no use made of electricity as a motive power.

The World's Columbian Exposition has placed contracts for 4,500 arc lights, of 2,000 nominal c. p. each, and received donations from miscellaneous exhibitors of about 700 additional. They have placed contracts for about 80,000 incandescent lights and received donations as special exhibits of about 10,000 additional. They have placed contracts for 2,900 h. p. capacity of power generators and received donations of 1,600 h. p. capacity. They have made contracts for electrical fountains requiring an installation of 900 h. p. capacity. The aggregate of power generators and fountain plant (the latter will be used particularly for charging the storage batteries of the electrical launches) is 5,300 h. p.

The total aggregate of the electrical installation therefore, amounts to 19,500 h. p. The total aggregate of boiler capacity employed is 18,000 h. p. on the standard rating of 30 pounds of steam per horse power per hour. With such efficiency as should be expected from the engines installed, this represents an effective total of about 24,000 h. p.

The most interesting point of this plant will be the use of oil as a fuel. From the time the crude petroleum is emptied from the railroad tank cars into the World's Fair storage tanks, at the extreme southeast corner of the grounds, this oil becomes part of the power plant, the pressure upon the delivery pipe being automatically controlled by the steam pressure in the boilers. Delivery to boilers is made by pipes laid underground from the storage tanks to the boiler house, and the oil is introduced into the furnace in an atomized jet.

A point of exceeding interest in the engine and dynamo room will be the very large adaptation of dynamos to Corliss and medium speed types of engines in direct-connected combinations. The largest of these will be a set of vertical triple-expansion engines with two connected armatures. At 60 pounds steam pressure this single unit will give most economically 1,200 h. p., with a capacity for continued service of 1,500 h. p. output.

Next to the universal distribution of electric power for all points of the grounds, the most marked advance of the time is the application of electricity to the transportation service of the Exposition. This service will be by a three mile double track elevated railroad following all the precedents and best practices in block signalling systems, power brakes and all other safeguards of the modern steam railroad used in exclusively passenger traffic. The entire operation will be, however, by electric power drawn from an independent power plant of more than the aggregate capacity installed at the Paris Exposition. In this power house will be found the latest examples of the large range of direct driven power generators, five in number, and aggregating 3,500 h. p. capacity. To those who have not had an opportunity of informing themselves of the part that electricity is expected to play at the Exposition, these figures will be interesting and will indicate to all how much greater by comparison with preceding expositions the Columbian Exposition is bound to be.

The sensational reports telegraphed from New York that many of the prominent electrical firms in that State had decided to abandon the space allotted to them and make no exhibit, were found on inquiry to be based on the fact that three small concerns had gone out for reasons that were personal to them. Every foot of space in the great building has been taken and every electrical concern of any consequence in the world will be fully represented. The active work of preparing for the exhibits has been going forward for some weeks and many of the electrical firms have made substantial progress in the erection of their booths.

The intellectual programme to be carried out under the auspices of the World's Columbian Auxilliary promises to be of remarkable interest. As you know, Prof. Elisha Gray is at the head of the electrical branch and he now has assurance that the gathering of electricians from all parts of the world will be a grand one.

At the conclusion of the reading of the foregoing report, the meeting adjourned until two o'clock.

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[1] See page 232.

TUESDAY AFTERNON SESSION.

The first business of the session was the reading of the paper on "Relation of Insurance to Electric Lighting and Power," by Mr. William Brophy.[1]

Mr. Hammer—It seems to me in view of Mr. Brophy's remarks that it is possible a closer union could be established between the National Board of Fire Underwriter's and the men who are actively engaged in the electric light enterprises, by having a joint committee composed of members of the National Board of Fire Underwriters and of the National Electric Light Association, who come together and compare notes and have a report issued which would be a joint report. From what the Chairman of the Board of Fire Underwriters told me there is a feeling of considerable jealousy on the part of that Board as regards the report issued by the National Electric Light Association. They feel that they should not be dictated to by this Association, and naturally enough we feel that we should not be dictated to by them.

Capt. Brophy—I have no objection to any rules that may be made by the Board of Fire Underwriters, so long as they do not exact undue concessions or place undue restrictions on the business. I have lately come into possession of certain rules issued by the National Insurance Board, as they style themselves. They vary but slightly from the rules issued by this Association; and I really recognize my own work in them. I suggest that our standing committee on safe-wiring before the next meeting compare these two rules, and if possible, work in harmony with the insurance companies; there is no occasion for having two sets of rules, or having any misunderstanding about them.

Mr. M. J. Francisco said he had been an insurance adjuster for about twenty-five years, and knew something about the knowledge which most of the insurance agents had about the electric lighting business. Nine-tenths of them do not pretend to know anything about the electrical part of the business. There were a few insurance men that understood it. The high rates were the result of the loose way of construction and arrangement which prevailed in many places. He would never place a dynamo on a flooring of timber; he would have a stone or brick floor laid in cement and place the dynamos on that. He could stand in one position in his station and see every wire in it.

Mr. A. J. DeCamp thought it might be impossible to adopt a rigid set of rules and make them apply to all stations alike. A rule that could be applied to the station which Mr. Francisco had just described might not be applicable to a station at another point. It had therefore occurred to him that it might be a good plan, instead of having the committee meet to consider and adopt the Montreal rules, to have it resolve itself into an arbitrating committee.

Mr. H. G. Issertel inquired why these rules are not universally accepted. He had found in certain cities of the same state a certain set of rules and in another city, especially in Pennsylvania, another set, entirely different, in vogue. He had found that many central station men were so disgusted with the way these rules were being handled that they give them very little attention.

Mr. E. A. Armstrong' thought the underwriters were the ones who should make the rules.

Capt. Brophy in reply to a question from Mr. De Camp said that he had had a large experience formulating rules; and it was his judgment that a rule was never yet made that would not be deviated from. There must be some discretion left to the constructor, to the man who is furnishing light, or to the insurance inspector. For this very reason, the committee was a standing committee, so that they could at any time add to, or change, or modify the rules, whenever it became necessary.

The paper by Mr. R. H. Sterling was then read on "Some Experiences with the Alternating System."

Mr. Sterling being called upon for a full explanation of the "booster" referred to in his paper, said that Mr. Wagner could explain it fully.

Mr. Wagner:—Mr. L. B. Stillwell is the inventor of the arrangement called the "booster," or more properly, the Stillwell regulator. It is rather difficult to explain it without the use of a diagram or blackboard. It is simply a converter arrangement used to raise the potential at will on any circuit or feeder, by means of a series of contacts usually differing about one per cent. The regulator as usually constructed may be used to raise the potential on any feeder from one to twenty per cent. It is a simple converter with ordinary coil connected in the usual way in multiple with the circuit or shunt to the secondary coil, which is adjustable in length, or has a number of ends brought out, placed in series with one leg of the feeder, and adding its potential to that of the line or the dynamo.

Mr. De Camp inquired as to the relative value of the alternating system, within a prescribed circuit, say of one or two miles, as compared with the direct system, with the machines coupled in multiple?

Mr. Wagner replied that as to the flexibility of the alternating system, and the possibility of using the station units to their utmost capacity, he had never in his practice found it necessary to run any station unit under seventy-five or eighty per cent. of its total capacity. By a very simple switchboard arrangement it is possible to connect as many circuits to one dynamo as is desirable, and as the load falls off the station, the units or dynamos are shut down and the feeders are gradually brought together on a few number of dynamos, and in that way the station apparatus can be used as economically and advantageously as with direct current. He coupled the circuits together instead of coupling the machines together, and that can be done without interrupting the service for even a moment on any circuit. It had now become possible to run arc lamps as well as motors on the alternating circuits, and he thought that it had at last become almost universally conceded that for most purposes the alternating current was as flexible as the direct current. In St. Louis they covered an area extending six or seven miles from the station in several directions. The station was situated almost at the centre of the district, in which they had between seventy-five and eighty thousand lights; they had never had any trouble from want of flexibility of machines or circuits.

Capt. Brophy thought that much trouble was caused by running, say, four or five circuits, none of which had the same loss; these would now be coupled together and do satisfactory work.

Mr. Wagner remarked that it was just as possible with alternating circuits as with direct circuits to use feeder regulators. In a properly constructed alternating system it was just as necessary to use a system of feeders and mains as with the direct system. Generally the same devices could be used for regulating either current; but the Stillwell regulator was a device which could only be used on alternating circuits, and was much more economical to use than any other form of feeder regulator, using resistance, as this regulator raised the potential of any one circuit instead of lowering it. The circuits with small amount of drop are left as they are, and those with greater load are raised in potential sufficient to bring the potential at the end of the feeder to the proper standard. It was customary in direct current systems to connect all the feeders and mains together, forming a complete and continuous network. It is claimed as an advantage for the purpose of keeping a uniform pressure throughout the system. In the speaker's opinion it was a distinct disadvantage in case of ground or trouble occurring on the line, as it then became very difficult to locate it. In the alternating system it was used to keep each feeder and its system of mains entirely separate outside of the station, simply throwing them together in the station. Any trouble occurring on one of the circuits is immediately indicated by the station instruments or fuses, and is located and confined to quite a small district. In the case of the Missouri Electric Light Company the loss in feeders varied from five to ten per cent.; the average probably being about eight per cent.; six per cent. in the feeders and two per cent. in the mains. It depended on the proportion between the average load and the maximum load. That differs at different seasons of the year.

Mr. Edward Weston: I do not think anyone is in a position to fully answer the question of loss raised by Mr. De Camp, namely, which is the more economical of the two systems. The systems as established here differ radically, in one respect at least, from the systems established on the other side. Here, for the purpose of economy in the first cost, a very high rate of alternation has been adopted. From present experience it seems as though this was a fundamental mistake, and that the mistake will be more apparent as the system has to be forced underground, which will come sooner or later. We must all recognize the fact that any system of aerial conductors can never give us the safe and sure service which is necessary to enable us to compete with a satisfactory and reliable source of illumination such as gas. If our alternating current systems of this country were forced underground, the loss would be, undoubtedly, greatly increased; but what the losses are exactly at present, I have not been able to find out.

The constant growth of the alternating current system indicates, however, one thing surely, namely, that it is filling a long-felt want and that it is a money-making investment at least, for a large number of people. Whether the system as it exists in this country to-day will not be radically modified in the next few years so as to approach more closely the systems of Europe is a question; but' I think it will. I think that will undoubtedly be done and the tendency will be toward a lower rate of alternation and greater general efficiency. Of course, you can get a general idea of the efficiency of the alternating system by keeping records of the total output per hour as indicated by the instruments, supposing them to be reliable, and then summing these up at the end of the month, or at shorter periods, if possible, ascertaining what your wattmeters or recording instruments indicate. You would have a rough check in that way. I noticed one remark in the paper in regard to the use of instruments. Instruments are generally placed on the switchboard, and quite frequently so near to the other apparatus as to make their indications unreliable. The speaker then mentioned a case in which the voltmeters on a switchboard were affected by a bus-bar two inches behind them carrying 1,000 amperes direct current.

Mr. G. H. Blaxter inquired whether in going underground with the alternating system the loss would be greater with the high number of alternations than with the overhead system. Mr. Weston replied that he should expect the loss to be greater on account of the inductive influences. He also thought that the concentric system of wiring met with serious difficulties, and that it would be found that there is a greater loss underground.

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[1] See p. 230.

Mr. Blaxter in reply to a question from Mr. Hammer said that comparing the alternating circuit with the direct current, he had not noticed any difference in the life of the lamps; but one thing he had noticed, and that is, that a lamp in the city in a store would burn out in a less number of hours than a lamp in a residence. Vibration, he thought, had something to do with it. He thought the shaking of buildings in the city had a serious effect on the life of lamps.

Mr. Ch. Wirt thought the difference in the life of lamps in stores and residences could be accounted for by the fact that the residence is generally further from the centre of distribution and the pressure is generally lower. He had made tests of that kind, and thought it pretty safe to say that was the usual state of the case. Regarding the difference in the life of lamps on the alternating and direct current, he thought that question had almost been settled by laboratory tests and results of large experience; the results having shown that there is practically no difference between the two.

Mr. E. G. Kilbourne—The question as to the relative value of the two systems depends largely on the field you are going to operate in. In Seattle we have both systems, and find they do not conflict; and we also find the alternating system just as flexible, and in some respects more flexible than the direct system. If you have a station which is so situated that you do not expect to go beyond a certain limited distance from the station, and your load is liable to be light at certain times of the day, and you want to run all day, there is no question that the direct current is the better and cheaper. The chronic condition of most stations is light load, and the direct system under these conditions is the more economical; but it is impossible to go beyond a certain distance with the direct current, so I think the question largely solves itself.

WEDNESDAY MARCH 1.—MORNING SESSION.

President Ayer called the meeting to order and announced the first business to be the paper by Prof. George Forbes, of London, on "Thermal Storage for Central Stations.[1]

Dr. Louis Bell thought that Prof. Forbes' plan of storing water power is one that can be worked successfully, quite aside from the matter of thermal storage and that thermal storage itself was a matter to which we should give our very careful attention.

Prof. Forbes in answer to questions gave the details of the Halpin system described in The Electrical Engineer of Feb. 22, 1892. In answer to a question as to the relative efficiency or cost of the system of the storage of water, which he and Prof. Forbes proposed, and that of thermal storage, which Mr. Halpin has proposed, Prof. Forbes stated that the running expense is almost the same in the two; but the economy of capital, if the reservoir is anywhere near the pumping station, is very much in favor of the water storage. The water storage takes off about 30 per cent. from the cost of a central station built upon the ordinary lines. That was so in the detailed plans which he worked out for the city of Edinburgh, Scotland. The thermal storage plant was rather more expensive to erect, but the annual saving on these two systems was about the same. In the old-fashioned method of building destructors it took ten pounds of refuse to produce the effect of one pound of good Welsh coal. Now they had reduced that quantity down to about five or six pounds of refuse to be equivalent to one pound of coal.

Mr. T. Carpenter Smith remarked that the boilers of hoisting engines were able to do work far in excess of the normal capacity of the boiler on account of the storage of heat in the water, similar to the principle of the Halpin system. The greatest doubt in his mind as to the success of this storage system was that identically the same thing had been tried in Boston, where a company was formed for the purpose of distributing power by hot water, called liquid steam, which simply meant water at a pressure and temperature corresponding to about 400 pounds. This water was carried through pipes, and when it was desired to use it in any building, the moment it escaped it became steam. The practical working of the plant was first-rate. The thing collapsed, however, through an unexpected difficulty; and that was the tremendous and rapid destruction of the pipes from the continual use in them of the highly-heated water. How that would affect a plant of this kind where one could use steel pipes he did not know. Perhaps Prof. Forbes could give them some information on that point.

Mr. Ch. Wirt drew attention to the so-called fireless steam locomotives in service in Chicago for many years, which were charged at one end with hot water under high pressure from an ordinary stationary steam boiler. He also inquired why the storage battery failed in comparison with steam storage.

Prof. Forbes—I made a direct comparison between the cost of batteries and of the thermal storage system. The loss in connection with the storage battery includes increased original expenditure in putting down storage batteries, which is far greater than the dynamos and machinery they replace, and also the great loss of efficiency—80 per cent. being the efficiency at which they work, there being a loss of 20 per cent. of coal; and also the depreciation account, which I think every one must admit is about twelve per cent. per annum. I have installed numerous storage batteries, but have never done so in a central station. I have done my best to try to find an economy in them, and if it were feasible, would have recommended them for central stations; but I have never found that batteries introduced in central stations would be a large economy. I know there are others who hold different views; but my experience leads me to the belief expressed. Storage batteries have their appropriate places, and I would like to see them much more used than at present in this country. There are a number of storage batteries of the Planté type that are available, and yet no one seems to work at them here.

Mr. L. B. Stillwell—The central station man who is paying for energy in the form of coal and selling it in the form of light is losing various amounts at each step of the process, but up to the present time he is losing far more before it gets to the dynamo than he is after it leaves the dynamo. I estimate that out of 1,000 h. p. that the central station man buys in the form of energy in coal, he may be able to sell two and eight-tenths in the form of light. He has lost in the various stops about 980 h. p. before he has reached the dynamo. In the electrical apparatus down to the lamp he loses, the remainder. I am glad to know that the steam engineers are attacking this problem of waste energy in the steam plants in a way that promises success.

Mr. T. C. Smith thought there was little to be gained by the use of storage batteries owing to the loss of 20 per cent., and because it would require the same amount of attendance as an engine and dynamo.

Prof. Forbes replied that a person of ordinary intelligence could be instructed in the care of the batteries in a few hours, and often this duty falls to the carpenter, or gardener, or even butler, on some of the large estates. Even in the larger plants, he did not think it necessary to have any one in constant service; but had instituted a system of daily and weekly inspection of the apparatus to see that everything worked efficiently, and to supply defective parts, and on the whole they met with much success.

Dr. Louis Bell thought that one reason why the storage battery had been such a failure on this side of the Atlantic was because it had been exploited from the time it first made its appearance here for the purpose of street car traction or other purposes to which it was least adapted.

Mr. W. J. Hammer thought another reason was that in England, France and Germany they use accumulators about the size of a trunk. Probably the small depreciation and commercial character of these accumulators was to a considerable extent due to the massiveness and the mechanical strength of the plates, and the cases in which the accumulator plates are placed.

Prof. Forbes remarked that the smaller cells, as long as they were large enough to be made in a solid, mechanical manner, lasted just as well, and their efficiency was relatively just as good as the large ones.

The convention then adjourned until two o'clock, P. M.

WEDNESDAY AFTERNOON SESSION.

The session was opened by the reading of three kindred papers as follows:

"Long Distance Transmission of Power,"[1] by Mr. C. S. Bradley; "Power Transmission for Central Stations,"[2] by Dr. Louis Bell; and "Under What Conditions is the Use of Water Power Economical?"[3] by Mr. L. B. Stillwell. These were discussed jointly.

Mr. W. J. Hammer, referring to the statement of Dr. Bell, that it was not practicable to use multi-phase machines of over 1,200 volts, reminded him of the fact that direct current machines were in daily operation at 3,000 volts and more. Moreover, Prof. Crocker had been running for some time direct current machines of 5,000 or 6,000 volts without any difficulty whatever. He did not think Dr. Bell had placed enough importance upon the application of the motor transformer in this country. It would be interesting to know just why alternating motors of large capacity were not in use.

Dr. Bell in reply said that he had stated in the paper that high voltage could not be used requiring the employment of 1,200 volts or thereabouts if the machine is designed to carry large currents. Experience up to date had shown that they would not work satisfactorily for any length of time. As to the direct current transformer he was very far from desiring to belittle it. The transformer which takes a current at 1,000 or 2,000 volts and brings it down to 100 or 200 volts may have a very direct application after we get the high voltage machine. But the tri-phase multiple transformer was very much more simple and efficient than the machine which takes a high voltage direct current and transforms it to a low voltage direct current. As to why alternating current motors in large sizes have not been used up to the present time, he thought the principal reason was that there had been no very large call for long transmissions until quite recently. It was perfectly practicable to run large synchronous motors; a matter about which there was no difficulty, and when occasion had arisen it had been done.

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[1] See p. 242.

[1] See page 236. [2] See page 238. [3] See page 235.

Mr. L. B. Stillwell remarked that the tri-phase system effected a reduction of about 14 per cent. in the amount of copper for the transmission circuits over that required by a two-phase system. But that did not mean that we must increase the potential by any such amount as 14 per cent. in order to come back to even terms on the copper expenditure. It was sufficient to go up about seven or eight per cent. The points on which the two-phase is distinctly and positively superior to the three-phase or any multiple system, were first that the two-phase required just two transformers at every point where the three-phase required three. To a practical man, this was sufficient to overrule all of the arguments in favor of the three-phase that had been advanced, assuming all of them to be correct. For a general transmission and distribution project where we must supply power for lighting and street railway and general purposes, we must abandon the single phase; we must produce a difference of phase in some way, and having done that, it seemed very desirable to stop at the simplest form of the multi-phase, namely, the two-phase apparatus.

Mr. C. S. Bradley stated that he had tried to build such alternating motors and had not been able to do it. He succeeded in building a 1 to 2 h. p. motor to work on a single-phase alternating circuit which had an efficiency of 52 per cent. He had never been able to construct one without a commutator, and wherever a commutator was used the sparking was excessive. If it was not bad when the motor is first started, after a few hours it became very bad.

Mr. Edward Weston did not agree with Dr. Bell in the statement that 1,000 volts was the limit of work for the direct current, giving anything up to 100 amperes. He was quite sure that with correctly designed machines there would be no difficulty in running up to 5,000 volts, and with very large currents, up to several hundred amperes.

Mr. Nunn:—I suppose my testimony in reference to the alternating long distance plant that we have been operating would be apropos. I can say that from the first installation to the present time it has been under my care, and I consider it a brilliant success, especially when I compare it with direct current systems which are in use around us. Our greatest trouble has been from lightning and from grounds, principally the latter. The lightning has caused many defects and made many of the plants failures. It must he understood that we are in an unusual place. Our generating station was something over 10,000 feet high and our first motor installed was something over 12,000 feet high. We have made a run of 45 days without a discharging field of motor or generator. We have installed a 250 h. p. machine, and that is giving satisfaction so far. We do find a little trouble with some minor details, but they are purely a matter of the mechanical construction of the machines and not a part of the electrical connections at all. Ours are of the synchronous type. We have to start our motors with a special starting apparatus, and we once in a while have a little trouble with that; that is, as far as the operation of starting is concerned, it is very simple. The men who take care of these machines, with two exceptions, are men who never saw an electric apparatus before. I think I have had 16 different men in the last year and a half in attendance upon one motor, and without any exception these men have been able to take care of the motor without any trouble. I think this is a compliment, not so much to the sagacity of the men, who were simply western miners, but to the simplicity of the system. We have but two men at the generating station working 12 hour shifts, and they control the speed for our five miles and control it exactly, whether the motors are loaded fully or running light. The speed varies so little that it is one of the great beauties of our system. It must be understood that we use these motors in driving stamp mills in the reduction of gold ore and perfect speed is a paramount requirement. I do not think that the time can ever come that in the electrical field can be found a system more beautifully applicable to these cases of long distance transmission in which large units (when I speak of large units I mean over 50 h. p.) are required at a constant and uniform speed on 365 days in the year.

Mr. Henry Hine thought that long distance transmission was one thing; transmission of power for various purposes in a city was another thing. His company had been operating motors for some time successfully under their own supervision. **Dr. Kilbourne** thought it a good plan to put transformers in large banks instead of putting a transformer in every building. They had a bank of transformers and at night when the heavy load went off the night-watchman threw off the switches of two transformers, if there were three in the bank, and left one to carry the load for the balance of the night. **Prof. Forbes**, being called on, said he was very sorry but he hardly felt able just at the moment, to say much about the relative merits of the two systems. Of course he would have occasion to express his opinions on that subject pretty clearly in the course of the next week or two, and thought it would be hardly right for him to draw comparisons between the two at the present time. He could only say that both the three-phase and the two-phase system were working very satisfactorily in Europe. The only town in the world that he knew at the present moment where alternating currents are used for distributing power is at Heilbronn, Germany, but there might be others with which he was not acquainted; that too was on a very small scale. This only showed that the objections which were originally raised against the alternating current for use as motive power have not been completely annihilated up to the present time. He had seen at least a dozen kinds of single phase motors in the shops of various manufacturers.

The President then laid before the Convention an invitation from the Siegel Gas Fixture Company to visit their establishment; also an invitation from Mr. Henry Sylvester to inspect a model of a special type of underground sub-way. Also a communication from the Columbian Underground Electric Traction Company inviting the Convention to inspect a new street railway system, underground conduit. Also an invitation from the St. Louis Car Company to examine a new model president's car constructed by it for the New Orleans street railway system and costing about $9,000. The Convention then adjourned until 10 A.M. Thursday.

THURSDAY, MARCH 2.—MORNING SESSION.

Mr. William J. Hammer, in response to the request of the president, read **Mr. W. H. Browne's** paper, entitled "Underground Conduits and Conductors, and the Experiences of the Electric Lighting Companies of New York City."[1]

The President: This question is peculiarly interesting to the companies in St. Louis, where the subject has been agitated in the last year or two. Efforts have been made to pass State laws compelling the companies to go underground in the cities of Missouri. The telephone company here has been endeavoring to get underground—endeavoring to get a franchise to go underground, but there is a difference between them and our local legislators, and they seem to be unable to get a satisfactory franchise. At the same time the local city government have been endeavoring to procure State legislation compelling them to go underground. No doubt many of you have had similar experiences.

Mr. De Camp stated as the result of his underground experience in Philadelphia that lights on the underground mains cost him 10 or 15 cents a night more than did those on the overhead circuits, and of course he had to charge more. There was no help for it. He understood, moreover, that the whole underground construction in New York to-day would not pay one per cent. on the investment in it. If anything, he favored the city building and owning subways, so that people might at least know what the heavy expense of subways was.

Mr. M. J. Francisco—There is no question in regard to the feasibility of placing these wires underground. That has been fully demonstrated. It is simply a question of commercial success. But at the present time it is almost impossible for a company in a place of 300,000 or 350,000 inhabitants to operate an underground circuit and pay expenses. As a general thing the cost of constructing the conduit would average about $4,500 per mile of one duct only. His view of this thing was that the city should construct the conduit and furnish it to the electric light companies at a reasonable rental. He recommended that the electric light companies, in states where conduits are to be used, should take such measures as would procure an enactment by the legislatures of those states of certain laws regulating the rental of conduits, so that there shall be a fixed rental made by the legislature of the state. Then they would know where they stood. The city should construct the conduit and rent it at that price, otherwise in small places it is utterly impossible to run or operate in a conduit.

Mr. J. J. Moore, of New York, went into a story of the manner in which lighting had been contracted for in New York, and in which prices had been raised owing to the introduction of the conduits which were more satisfactory than overhead wires, but it was only the commercial lighting that saved the local companies. He did not favor the building of conduits by cities. If they built them, it would only be the next step to pull wires in for themselves, and then it would be a "municipal plant." The local company should protect itself by owning the conduits it was using.

At this stage the discussion took a turn that led on to the competition and cutting of rates, whereupon the President announced the next paper on "The Incandescent Lamp from a Commercial Standpoint[4]" by Calvert Townley.

The paper was read and the meeting was then adjourned until 2 p. m.

THURSDAY AFTERNOON SESSION.

Vice-President Armstrong called the meeting to order. The first business was the reading of the paper of Mr. H. C. Meyers on "The Vulcanizing Process for the Preservation and Strengthening of Poles, Cross Arms, Ties,[2] etc."

The paper of Mr. E. A. Armstrong, on the "Morals of Corporations,"[3] was read as follows:—

The discussion on the paper of Mr. Calvert Townley, on "The Incandescent Lamp from a Commercial Standpoint,"[4] which was read at the morning session, and discussion on which was postponed until the afternoon session, was then taken up.

A rather general discussion was participated in on the relations of the supply companies to central station men which was incidentally introduced.

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[1] See page 241. [2] See page 233. [3] See page 231. [4] See page 237.

Mr. Edward Weston gave a most interesting description of the successive stages through which the incandescent lamp has passed, as regards the production of the carbon and guarding against the rapid destruction of the lamp.

The discussion concerning the local companies and the lamp policy of the General Electric Company was participated in by Dr. Bell, A. J. DeCamp, T. C. Smith, J. J. Burleigh, and W. S. Howell. It was very acrimonious and needlessly personal and was virtually expunged from the record.

The question was referred to the Committee on Relation between Manufacturing and Central Station Companies.

Mr. Armstrong offered the following resolution:

Resolved—That the sincere thanks of this Association are due and are hereby tendered to the Citizens of St. Louis, the Electric Club, the Electrical Exchange, the Bell Telephone Company and the city press for the very full reports, as well as to many others, for the very elaborate courtesies they have extended to us, which have rendered our stay here so exceedingly pleasant. We have discovered that the kind proffer of His Honor, the Mayor, in his welcoming address, has been liberally realized:—"St. Louis and all that she has is ours."

The resolution was unanimously adopted.

Mr. Armstrong offered the following resolution:

Resolved—That we extend as an Association and individually our thanks to our esteemed President James I. Ayer, for the ability and courtesy with which he has discharged the responsible official duties of his position. As individuals we want to put on record the fact that from our experience here in St. Louis at this convention, we have learned that his affability is perfectly generated; it is of the highest efficiency, the lines are innumerable and are all overground; the current is sent out without a drop or flash, and on these lines there is no switchboard, throw out, cut-off or arrester; and against its power no amount of trouble has been able to act as an insulator.

The resolution was unanimously adopted.

President Ayer responded to the resolution and expressed himself as pleased to know that the delegates had been so well provided for; and said that he, in turn, was indebted to the citizens of St. Louis for the earnest efforts they had put forth on this occasion.

He thanked the gentlemen for the attention they had given to the meetings of the Association.

At this point the regular sessions closed; and the meeting went into executive session.

An interesting feature at this time was the passage through Tenth street of the vehicles used in the service of the Municipal Electric Light and Power Company of Mo., of which Mr. Ayer is general manager. The procession consisted of the superintendent's light wagon, pole wagon, dynamo wagons for the handling of heavy machinery, linemen's wagons, trimmers' carts, inspectors' carts, line repairers' carts, metermens' carts, and one or two other kinds of carts; the whole aggregating about eighty. The company serves a territory of upwards of sixty square miles in St. Louis, and finds these vehicles necessary in the conduct of its business.

In the executive session the Secretary's report was read, which showed the Association to be in a most healthy financial condition.

There were 31 new active members gained during the year; and the total membership of all classes is now 250.

Nikola Tesla and James I. Ayer were elected as honorary members of the Association.

A hearty invitation was given to the Association by Dr. E. C. Kilbourne, of Seattle, Wash., for the Association to meet there next year. The invitation was most cordial, and went to the extent to state that the expenses of every one in attendance at the meeting would be paid by the citizens of Seattle.

The following were then elected the officers of the Association for the ensuing year:

President, E. A. Armstrong, Camden, N. J.
First Vice-President, M. J. Francisco, Rutland, Vt.
Second Vice-President, C H. Wilmerding, Chicago, Ill.
Secretary, George F. Porter, New York.
New members of the Executive Committee: J. A. Seely, New York; E. F. Peck, Brooklyn; A. J. DeCamp, Philadelphia; W. A. Morrison, Woodstock, Conn.; H. J. Smith, New York; G. H. Blaxter, Pittsburgh.

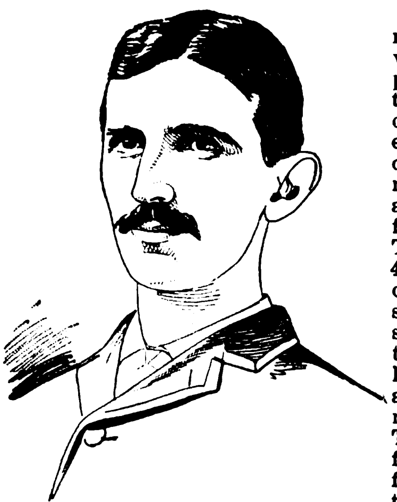
The place for holding the next meeting was referred to the Executive Committee.

The convention then adjourned.

DONALDSON-MACRAE ELECTRIC CO.

It was at Baltimore that the first Faure storage battery which arrived in this country was landed, and that city has ever since been the scene of activity in this field. Among those who have more recently devoted attention to storage battery work are the Donaldson-Macrae Electric Co., of No. 215 N. Calvert St., Baltimore, whose batteries have been put to use for a variety of light and power purposes, and some of whose installations have already been described in the Engineer. The active material in the Donaldson-Macrae cells is entirely enclosed by a perforated lead pocket so that under no conditions can it become loose and fall away from the plates. We may add that the company is operating under license from the Consolidated Electric Storage Company, of New York.

THE TESLA LECTURE IN ST. LOUIS.



Nikola Tesla.

The Tesla lecture was a notable feature of the convention. At first it had been proposed to deliver the lecture in a small hall, but the demand for tickets was so enormous that it was decided, as a matter of sheer necessity, to secure a larger auditorium, and this was found in the Exhibition Theatre, which seats about 4,000 people. It was, of course, practically impossible that all could hear and see, but those who were there could at least say they had seen Mr. Tesla afar off and witnessed some of his most striking experiments. The hall was crowded to suffocation. and the demand for tickets was so great that they were selling briskly for three and five dollars on the steps of the hall. Under such circumstances Mr. Tesla contented himself wisely with showing some of the more "spectacular" of his experiments, and even these were followed at a disadvantage in view of the immense distance from which most of the spectators studied them. After his introduction by Mr. Ayer, the lecturer gave a few minutes to a statement of the conditions involved in his work, and then by means of his high frequency and high voltage currents, aided by disruptive discharge from a condenser through an induction coil—as well as by direct dynamic phenomena, he produced a number of the interesting results that have already made his name famous and have charmed two worlds. He received, unhurt, currents of hundreds of thousands of volts, lit-up tubes and lamps through his body, rendered insulated wires several feet long entirely luminous, showed a motor running under the influence of these million-frequency currents, obtained a number of effects with phosphorescent lamps; and also showed how little in such work the high resistance of the filament had to do with the lighting up of ordinary 50 or 110 volt lamps. His ability to produce such effects, either with a single wire and no return, or without any wires at all, aroused the utmost interest and enthusiasm and the concluding demonstration literally brought down the house, when he showed how by simply carrying lamps or tubes into a room or hall where those currents were being developed, illumination was the immediate result.

In his opening remarks Mr. Tesla enlarged upon the grandeur of Nature, and expressed his opinion that the most wonderful of the external influences that affect us is light. Hence it followed that the most wonderful and important of the organs by which these external influences beat in upon us is the eye. Two facts were specially referred to, one of them being that the eye is the only organ capable of being affected directly by the vibrations of the ether. Another fact was that the eye would be able to distinguish objects at almost any distance, were it not for the minute particles and stray gases filling the intervening space. These absorb the energies of the ether vibrations, but in a pure medium they would travel unchecked, and the range of vision would be infinitely greater. Mr. Tesla then alluded to the importance of the part played by the eye in furnishing the race with its ideas and knowledge, and to its vital function in controlling all our motions and actions. From its teaching were derived consciousness, ideas, conceptions that were impossible without images—and images involved sight.

By these interesting stages, Mr. Tesla led up to the subject of light and thence to the part of electricity in giving us light. The general aim of the discourse was to show and explain the phenomena due to electrostatic forces, followed by phenomena produced by electro-dynamic agencies; and, then, as a third class, the light effects, Mr. Tesla's idea evidently being to give a generalization of these phenomena, and of their relations. It was stated, parenthetically, with regard to the physiological effects produced with the high tension, high frequency currents employed, that a great amount of energy may be sent into the body of a person by their means, merely because the energy was dissipated laterally from the body and was not passed through the body in the direct manner involved in the use of a low frequency current. It was due to this intense rapidity of vibration that the lecturer was able to receive with impunity currents of as high as 250,000 and 300,000 volts, and of an amount which otherwise administered would kill. The lecturer explained that he had so arranged his apparatus that in case of any failure of any part of it, the current would kindly abstain from killing him, and would only knock him down.

Many of the experiments shown have already been seen either in this country or in Europe, yet there were several novel effects introduced, and even the familiar experiments were performed with apparatus different from that used before. In most of the experiments the ordinary alternating and continuous currents from the central station were used, although Mr. Tesla also had his own special generator running in the basement.

A striking new experiment was to show at the beginning of the lecture, the effect of a varying electrostatic stress through the dielectric. This experiment was performed by grasping one terminal of the high tension transformer giving about 200,000 volts pressure, and approaching the other hand, to the opposite terminal. Streams of violet light then issued from the fingers and the whole hand. (At the lecture on the preceding Friday at the Franklin Institute in Philadelphia, Prof. Houston noticed these streams of light coming also from the lecturer's back, following roughly the line of the vertebral column).

Another experiment was performed showing the action of the air between two condenser plates. By attaching these plates to the high-tension transformer, the whole space between these plates was filled with light, the distance apart being about ten inches. It was pointed out that these streamers consumed considerable energy and developed abundantly ozone and nitrous acid, and it followed that it was necessary to exclude air from high-tension apparatus.

The action of the air was shown in another very striking experiment. Two incandescent lamps exactly alike, one exhausted, the other not, both of the ordinary 50 volt type, were attached in multiple arc, and a current vibrating about one million times a second or thereabouts was passed through the filament. It was demonstrated that the lamp which was exhausted glowed brightly, whereas the other one in which the filament was surrounded by air, at ordinary pressure, did not glow. Yet the latter lamp got hotter than the other. This showed the great importance of the rarefied gas in the heating of a conductor, and it was pointed out that in incandescent lighting a high resistance filament does not at all constitute the really essential element of illumination, along these lines. Also that heavy blocks of metal may be brought to incandescence by minute currents provided they are surrounded by rarefied gas, and provided the potential and frequency of the currents is sufficiently high.

One of the most interesting experiments was the conversion on open circuit. A transformer was taken and the current passed through the high tension winding in such a way that only one terminal was attached to the source of the rapidly alternating current. In spite of this there was a current passing through the primary as though the other terminal was actually attached to the source like an ordinary return circuit. This open circuit transformer contained a secondary low tension winding, and the minute currents passing through the primary were transformed into currents capable of following the ordinary electric wire and lighting up brilliantly an ordinary lamp. It was pointed out that under certain conditions, indeed, such a conversion was quite practicable and that it can be practised with high economy. It was further pointed out that any kind of device such as motors, etc., may be operated in this manner, with one wire or circuit only.

Mr. Tesla in the course of his lecture dwelt upon his method of conversion by means of disruptive discharges from continuous or alternating station supply. There were two kinds of apparatus on the stage, one operated from the alternating circuit and the other from the regular direct current system. A peculiar form of discharger was used contained in a mica-lined wooden box. The spark-gap was warmed by a small lamp underneath, for the purpose of making the air dielectrically weak. This enabled Mr. Tesla to work with a very long gap, a very sensitive arc, and a comparatively small electromotive force in the gap. The effects obtained were thus augmented very materially. It was pointed out that with this method of conversion, there is no difficulty whatever in obtaining sparks of any length. It becomes simply a question of the energy supplied, through what distance the spark will be visible. During the lecture, lamps were operated by this method of conversion. An ordinary 100-volt, a 50-volt and a two-volt lamp were brought up to full candle-power with equal facility. Then a little motor was run by means of these disruptive discharges, it being a phase-motor comprising simply an iron core with a closed secondary coil in it, and a disc armature arranged to rotate above the core. Mr. Tesla remarked rather naively that if the demonstration were not quite equal to the expectation, the long continued and weary work on the development of the invention, besides the inability of the experimenter, might be the cause. He went on, in connection with this, to refer to the transmission of power from Niagara and gracefully recognized the presence on the platform of Prof. George Forbes, who is so prominently identified with this great work. Mr. Tesla believed that we were about to see such great powers transmitted long distances, and over one wire.

Continuing, Mr. Tesla remarked that he had shown things of a more spectacular nature with reluctance, yet forced thereto by the desire to gratify those who had shown their interest and formed so large an audience. A number of experiments were performed not seen in this country before, though some had been shown in England. For instance, a phosphorescent bulb was lighted up by being merely held in the hand, and this was a most successful experiment. Mr. Tesla prefaced it by relating a little anecdote of Lord Rayleigh. When he was in London, remarked Mr. Tesla, with much feeling, he had the pleasure of performing this experiment privately before Lord Rayleigh, and he would always remember the trembling eagerness and excitement with which that distinguished scientist witnessed the lamp light up. The appreciation of such men, said Mr. Tesla, repaid him fully for the pains he had been at in working out these phenomena.

In this experiment a number of tubes were taken and flourished or flashed in various ways, and with the current made intermittent at longer intervals by adjusting the spark-gap. Wonderfully beautiful effects were thus produced, the light of the whirled tube being made to look like the white spokes of a wheel of glowing moonbeams. Then some rectangular tubes were taken and flashed or whirled so as to produce curious designs of luminous lines.

A bulb was shown by Mr. Tesla said by him to be so highly exhausted that when the bulb was merely attached to one terminal of the disruptive discharge coil, it would send the sparks across the outside of the globe to the other terminal, which was on the opposite end, rather than pass through the bulb. The bulb in question was painted on one side with a phosphorescent powder, or mixture, and threw a most dazzling light, far beyond that yielded by any ordinary phosphorescence. It was pointed out that there was no difficulty whatever in obtaining powerful phosphorescent effect in this way, and that a practical illuminant on these lines needed merely the perfection of the method of conversion above alluded to.

In conclusion the lecturer made fine cotton-covered wires stretched on a frame over the table luminous so that in the dark they looked like attenuated violet caterpillars yards long; and then within a large rectangle formed by such wires he flourished tubes in the interspace, these tubes flashing with light wherever waved.

After the lecture, so great was the desire of the public to see Mr. Tesla closer, an informal reception was held in the lobby when several hundreds of the leading citizens seized the opportunity and Mr. Tesla's hand in a very vigorous manner.

It should be added that the Electrical Exchange, of St. Louis, presented Mr. Tesla at the beginning of the lecture with a magnificent floral shield, wrought in white carnations with a border of palms and American Beauty roses. It was about four feet in diameter. In the centre was a circle of red carnations bordering a tablet of white ones, beaing the letters in red $C = \frac{E}{R}$.

Around the circumference were the floral letters: "St. Louis Electrical Exchange 1893."

THE CONNECTING LINK BETWEEN CHICAGO AND DETROIT.

On Saturday Evening, February 18th, occurred the successful opening of the Chicago-Detroit Long Distance Telephone line. The event was celebrated at Detroit with a great deal of enthusiasm, as it was the first introduction of that city to the long distance telephone. The mayor and all the city officials and a large number of prominent citizens were in attendance. At the Chicago end of the line were F. A. Baker, representing his brother, Wendell Baker, contracting agent of the long distance company; D. Richardson, and Special Agent Fuller, of the Bell Company; De Wolf Hopper, and F. L. Grannis, the banjoist, and a number of newspaper men. It was 6 o'clock when the line was opened and the Detroiters sent the first greeting over the wire to Chicago. The line was in excellent order and every word could be heard distinctly.

The line is the same in its construction as that between Chicago and New York. At Detroit communication was opened with New York, Pittsburg, and other cities east at the same time the Chicago line was opened. Mayor Pingree of Detroit, talked with Mayor Gilroy of New York, while Ex-Governor Alger had a conversation with Ex-Senator Warner Miller at the Fifth Avenue Hotel in New York. In addition to music from Chicago, the Detroiters heard in turn a cornet solo at New York and a recitation at Pittsburgh. The arrangements at the Detroit end were in charge of Wendell Baker, contracting agent, and Mr. Stoughton Walker, district superintendent of the Western division, including all the lines west of Pittsburgh.

UNION OF GERMAN ELECTRICAL ENGINEERS.

A call has been issued by a number of prominent German electrical engineers for the founding of a society to be known as the "Verband der Elektrotechniker Deutschlands." The object of the society is to promote friendly intercourse among members of the electrical profession, the cultivation of scientific and national interests in electrotechnics, and the creation of a body, which shall have the power and be in a position to express and represent effectively the consensus of electrical opinion in Germany. A considerable number of members have already joined the society.

EXHIBIT NOTES.

The Electric Selector and Signal Company.—All the central station men flocked to parlor 54, where something that was new to many of them was shown in full operation. This was the very well-worked out system of individual cut-outs of the Electric Selector and Signal Company (formerly the Electric Secret Service Company), of New York. The room where these devices were shown at work had the appearance of a small central station. In one corner was a C. & C. motor, supplied from one of the street circuits, driving a similar machine as a dynamo. This generator supplied current for a new form of Lundell motor and for the lamps and motors used for showing the operation of the selective switches. A number of these were arranged on a single circuit and each controlled a loop containing a "translating device" in the form either of a group of incandescent lamps or a Lundell fan motor. The central station transmitter governing the selector was placed near the generator to correspond with the position it takes in practice in the central station. The transmitter is a simple clockwork movement driving a disc for operating the circuit breaker. On the discs are cut the combinations corresponding to the selectors. A single depression of the key of the transmitter drives the disc a complete revolution, working out the combination of makes and breaks on the circuit breaker. Each selector has a separate and distinct combination to which alone it responds, and although the current passes through all on the line only the desired one operates its automatic switch, cutting the loop which it controls in or out of circuit. The switch alternately makes and breaks so that the operation of closing is the same as that for opening the circuit. The operativeness of the system was completely demonstrated and the exhibit shown was sufficiently extensive to make clear its applicability to the control of circuits of all kinds at points distant from the central station. Every central station manager who inspected the working of the system was impressed with the advantages it contained in placing the control of all circuits where it belongs, *i. e.*, at the generating plant or centre of distribution. The principle of individual selection has many other applications in different branches of electrical work, such as telegraphy and block signalling, and the Electric Selector and Signal Company has already done some very successful work of this kind for different railway companies. We see a large field of usefulness for this system. Those who are interested in making a more exhaustive inspection than was possible at the Convention can see a very complete installation of the various devices at the Company's headquarters, at 45 Broadway, New York.

The Weston Electrical Instrument Co., of Newark, made a really magnificent exhibit under the care of Prof. R. O. Heinrichs and Mr. C. D. Shain, while all the delegates were delighted that Mr. Edward Weston was present as a guest of the Association and to be able to discuss with him the principles upon which his beautiful instruments are based. Encouraged by the warm appreciation that has greeted his portable instruments of the permanent magnet type, Mr. Weston has now taken a most important step and has devised some of the best and finest central station voltmeters and ammeters, of the same type, that this country has ever seen. Some of these instruments were shown in circuit. With them were also shown the ingenious shunts used with the ammeters, and the leads that go with the apparatus; so that any central station man could realize correctly just how he could apply such instruments in his own station. There was also shown in the Weston parlor a superb direct reading laboratory voltmeter as well as an interesting and fascinating board on which were mounted separately all the details that are used in the Weston instruments. It was indeed a showing of fine workmanship, choice materials, and subtle adjustment of parts to purpose, that any inventor might well be proud of. Mr. Weston's high standing will certainly not suffer from such a display as his company made in St. Louis. It should be added, that, in order to meet the demand that comes to them, they have also made, and showed, a line of electromagnetic instruments in which the variability to which such instruments are liable has been reduced to the smallest minimum, so that they are practically free from variation.

The Goodrich Hard Rubber Co., of Akron, O., were well represented by Mr. J. C. Pierrez, who made it a personal duty to "round up" with every man in the Convention in anyway likely to be interested in such articles as the concern produces. Hard Rubber in an endless variety of forms has come to be a necessity of most of the modern work in electricity. In fact without it, many of the applications would be well-nigh hopeless. The Goodrich Company were early in appreciating this fact, and their goods, both by variety and excellence, have come to hold a most enviable, yet entirely deserved reputation and position in the trade and art. Mr. Pierrez did not deem it necessary to make an exhibit or to load up the delegates with samples. "Wherever you go in electrical St. Louis, you will find our product," he said.

Mr. D. Spruance represented the new Helios arc lamp for alternating circuits. It was shown in various places and gave a beautiful steady light, while its low voltage, simplicity and general availability found it many admirers. The Helios lamp seems destined for wide use.

The Electric Engineering and Supply Co., of Syracuse, had an exhibit of some of their handsome specialties in parlor 74. Among them was their handsomely mounted concealed terminal station switch which has no superior in style, mechanical construction or finish, and received unqualified praise and approval by all electricians and laymen. Another piece was their flush switch for the conduit system of wiring. It is claimed to be by far the handsomest switch of its kind and evokes universal praise. They also showed a porcelain-covered branch block, which, by means of a porcelain cover has all the brass parts perfectly covered, and is approved by the board of fire underwriters; also a few samples of their E. E. & S. sockets which are so well known on account of their peculiar and desirable quality of porcelain insulation and their unusual capacity for heavy currents. There was also shown a new fusible wall socket which is a combination of socket and fusible rosette; also a complete line of incandescent snap switches. This company are making a large number of incandescent switchboards, and arc plug boards, of which they showed photographs and designs. They are making these boards in any desired style and plans and prices. Mr. Goercke was in charge of the exhibit.

The Boston Incandescent Lamp Co., of Boston, Mass., had an attractive and interesting exhibit of their new series lamp, to be used on arc circuits. This is an important field of work that has been greatly neglected. The manufacturers of this lamp have had considerable experience at the Thomson-Houston factories, and are now producing a perfected series lamp at a very moderate cost. Central station managers desirous of increasing the carrying capacity of their series arc circuits, should write at once for prices and descriptive catalogue. The exhibit was in charge of Mr. Matt Merritt, of the company.

Mr. Chas. D. Jenney, of the Jenney Electric Motor Company, was here, there, and everywhere, like his motors, in the interests of his company. The company were without an exhibit at the Convention, but this was hardly necessary, however, for the position of popularity held by Jenney apparatus is now world-wide. Mr. Jenney is one of the youngest and yet one of the oldest in the electrical manufacturing business. The Jenney Electric Motor Co., of which Mr. Jenney is the head, is among the most prominent and have one of the most completely equipped factories in the country.

The Eddy Electric Mfg. Co. were well represented by Messrs. Newton and Baird and had a fine display in one of the large vacant stores in the hotel. It included their new type of motor, and of these two were shown, one being 15 h. p. and the other 1 h. p. These machines are characterized by all the simplicity, strength, and high finish which, combined with other qualities, have done so much to place Eddy motors and generators in the front rank. The company also had on the ground, the brothers G. E. Kohler and Frank Kohler, who are so successful in the Chicago agency.

Mr. E. V. Matlack, of the Laclede Power Company, of St. Louis, had an interesting exhibit of C. & C. motor and generator furnishing current for the exhibit of the Electric Selector & Signal Company. He is running a large 500-volt power plant in St. Louis, with C. & C. generators and motors, carrying as much as 30 h. p. in one lump three miles from the station. The plant used at the hotel for the exhibit is to be set up in the new telephone exchange to charge storage batteries for ringing.

The New York Insulated Wire Company were represented by Messrs. J. W. Godfrey, from New York and the boundless West, and Mr. E. Ruebel, of St. Louis. The latter gentleman rather had the advantage of the former by distributing neat little souvenir pocket books containing a choice Godfrey portrait adorned with prize Dutch skate moustaches. The picture is taken full tone, as it was found that half tone was not equal to the work.

The Cutter Electrical & Mfg. Co. had an interesting exhibit of specialties in their parlors, including flush switches, push button switches, etc. Their "flexible bracket" is too well and favorably known to need mention. Their new commutation switch is worthy of a careful examination. This switch admits of the operation of any number of lamps from any number of stations. An example of its working is the operation by one switch of the lights in six different rooms of a residence. Mr. H. B. Cutter was personally in charge.

The Mosher Electric Co., of Chicago, whose arc lamps for direct and alternating arc circuits were illustrated and described in the last issue of the Engineer, were shown in the hall of the Electric Club, in the Equitable Building, under the aupices of the Western Electrical Supply Co. of St. Louis, who also showed them at their offices.

"Tommy" Grier and his Chinamen were on duty during business hours extolling the merits of the Bryant Specialties, for which he is Western agent. "Tom" is well-known, well-liked, and is doing an excellent trade. A desirable line of goods is carried and their storerooms are always fully stocked.

Norwich Insulated Wire Company.—The above-named company was represented on the Electrical Special and at St. Louis by its treasurer, Mr. George J. Jackson. Mr. Jackson had the pleasure of showing many of the delegates and visitors his case of samples of fine cables—paper insulation and lead covered—ranging in size from No. 20 house wire to one of 2,000,000 circular mils for station and conduit service. These wires are water and fire proof. One of the interesting novelties shown by Mr. Jackson was a corrugated lead covering, the corrugation facilitating the drawing-in process in conduits. The ribs were $\frac{3}{32}$ inch deep and $\frac{1}{8}$ inch apart. Another novelty was a concentric double cable, the inner conductor being a No. 4 copper wire and the outer one being a cylinder made up of a ribbon of copper—the conductivity of the cylinder being equal to that of the inner wire. This cable has many obvious advantages over the ordinary two wire cable and in view of its superior insulation and compactness, will doubtless enjoy a wide sale. The offices of the Norwich Insulated Wire Company are at 44 Broad street, and their factory at Harrison, N. J.

Westinghouse Electric Mfg. Co.—Messrs. Calvert Townley, L. B. Stillwell, A. J. Wurts and E. H. Heinrichs, of Pittsburgh, Mr. C. E. Bragg, of Philadelphia, Mr. C. W. Stewart, of Chicago, and Mr. E. W. Seymour, of New York, were at the convention in the interests of the Westinghouse Electric & Mfg. Co. Mr. Heinrichs distributed a very interesting stopper lamp folder, and filled the local papers full of "three star" Westinghouse oratory.

The C. W. Hunt Co.'s illustrated catalogue distributed at the convention was very interesting to many showing as it did views of the almost unlimited classes of work turned out by this well known concern. This company make nothing but the highest class of machinery from the very best materials.

Mr Walter C. McKinlock renewed acquaintance with his many St. Louis friends. Mr. McKinlock is now President of a successful Supply Co., (The Enterprise Electric Co.) in Chicago, maintaining as well a St. Louis branch, with Mr. Ferris as manager. N. I. R. Seamless Rubber Insulated Wire was a general topic of conversation.

The Fibrone Terraloid Co, of Newark, N. J., had an exhibit of their many specialties for use in the manufacture of lamps sockets, etc. A handsome paper weight of their peculiar compound was eagerly sought for, but somehow very few got around.

Ernest and John—poles and ties—otherwise explained means the Valentine Clark Company. They were there doing their utmost in the interest of their company; in fact Ernest filled his pockets so full of orders that he was obliged to leave for home a day early to give them proper attention.

Schieren Belts.—A 72 inch perforated four ply leather belt made by the Chas. A. Schieren Co., of New York, attracted a great deal of attention. The New York office of this well-known company was represented by Mr. E. P. Atkinson. and the Chicago office by Mr. A. W. Harvey.

Jewell Belting Co.—A very handsome and "useful" souvenir was the pretty morocco paper currency folder presented by Mr. C. E. Newton and Mr. Wheelock, who were on the ground in the interest of the Jewell Belting Co. of Hartford, Conn.

J. R. Coffman is now posing under a new cognomen that of "Eureka." He showed a handsome line of Street Car Motor and Generator Segments for all systems, also segments and brushes for all systems of lighting machines, both arc and incandescent.

President J. W. Wilshire of the Card Electric Motor and Dynamo Co. spent a couple of days at the Convention in the interests of his company, which is now in better shape than ever to handle the large and solid motor business which it has built up.

Carpenter Rheostats.—The popularity of the Carpenter Enamel specialties is undeniable. Many who were unable to see Mr. Carpenter before leaving were heard asking, "Has Carpenter gone?" When told that he had gone and his exhibit with him, they were very much disappointed.

Mr. P. C. Burns, of The Laclede Carbon & Electric Company, will shortly make his headquarters at Chicago. He is likely soon, being an old telephone man, to make a profitable straddle between electric lighting and telephony.

President Henry C. Adams, of the Phillips Insulated Wire Co., was there in the interests of his Company. A countenance beaming with pleasure at all times, suggested interviews of material benefit to his company.

Ned Fox, of the Phœnix Glass Company, of New York, did not arrive at the scene of action until Friday morning. A great many visitors had left but those still around were glad to greet him.

The Heisler Electric Co. needed no introduction to St. Louis, where it was once emphatically a pioneer. It was represented by Messrs. Walter F. Smith and W. S. Horry, who are now building some very fine large alternators and pushing into an entirely new field of work.

Novel Advertising.—Among the many novel advertising schemes resorted to, the Electric Appliance Company will have to be given the first prize for originality. In addition to numerous circulars of their specialties and a small pamphlet of testimonials entitled "What others Think," which was attractive enough to deserve special mention, they kept their friends supplied with first-class cigars bearing the "Paranite" label, which is a sufficient guarantee that they were the best to be had. The great strike however was their quill toothpick bearing the legend: "Electric Appliance Company, Electrical Supplies, Paranite Wire, Chicago." The dining room of the Southern Hotel was supplied with these during convention week and each guest at the Friday banquet at the Jockey Club secured a package. The toothpicks were made of celluloid in assorted colors in the form of quills; and tied up in packages of ten or a dozen, the bright colors gave a very pretty effect. It was certainly a very original advertising scheme.

Mr. Thos. I. Stacey, treasurer and manager of the Electric Appliance Company made his first bow to an electric light convention. All enjoyed his "Paranite" cigars and were glad in consequence to make frequent calls on Mr. S. A very interesting grip full of their well-known specialties was taken down to the convention. This fact, the cigars, etc., made him at all times the recipient of plenty of calls. He returns home a thorough conventionalist and we think from his very pleased air that the inner vest pocket must have contained some handsome orders for "Paranite," Elkhart Transformers, etc., etc.

Standard Electric Co.—The excellent system of arc lighting manufactured by the Standard Electric Co. of Chicago has made a most flattering "entree" for isolated work in St. Louis, some handsome contracts having recently been secured. Mr. D. P. Perry, president and Mr. F. E. Drake were on the ground and were kept busy extolling the merits of their dynamos and lamps. This company have most excellent facilities and manufacture everything necessary for the electrical equipment of an arc plant.

Mosher Electric Co.—The interests of the Mosher Electric Company were admirably taken care of in the hands of president G. L. Reimann, and Mr. Mosher inventor of the Mosher arc lamp. The alternating arc lamps were on exhibition at the store of The Western Electric Supply Company, and two of their direct current incandescent arc lamps were shown in the rooms of the St. Louis Electric Club.

Mr. Harry Wilson did excellent work holding down the western end of the C. & C. Motor Company's interests. Power was secured and one of these well-known motors was in running "order" at all times to interest the many callers at Mr. Wilson's parlors. Treasurer Hall of the C. & C. Company was also present and busy.

Mr. A. D. Adams had a manifold duty to perform. Besides contributing a most valuable and interesting paper, he had the interests of his company, The Commercial Electric Co. of Indianapolis, to look after. It is needless to say his duties were well taken care of.

Jas. J. Murray & Co., of Philadelphia, who have deservedly captured so large a portion of the glassware trade in the electric lighting field, were on hand to greet old customers and to secure new ones. They find a growing appreciation of their artistic products.

The American Electrical Works were represented at the convention by Mr. P. C. Ackerman. This is not strange however for a convention without P. C.'s familiar face would be a surprise. The Works are still making a very superior brand of playing cards.

Mr. A. M. Morse, resident manager of the Buckeye Engine Co., was a frequent caller at headquarters whenever it was possible to leave his handsome offices in the Commercial building; a roll of specifications usually accompanied him.

Diehl Motor Co.—There were many interested readers of the widely distributed circular of the Diehl Motor Co. These motors have a long record of meritorious work. They have been described in the columns of the **Engineer** already.

Mr. C. J. Butler, manager of the Indiana Rubber and Insulated Wire Company was a day late in showing up at the Convention, but he "was there." Butler and Stacey made a decidedly strong Paranite team.

The many Friends of Mr. Geo. Cutter regretted to hear of his, to be hoped only temporary, indisposition which necessitated his immediate return home.

R. B. C.—Of course all know that these initials in reality "stand for" Ward Arc Lamps. Mr. Corey took admirable care of the interests of the Electric Construction & Supply Co. of New York.

H. T. Paiste attended the convention entirely on his own behalf, and found so many admirers of his products that he may soon be tempted to bring out a new line of specialties.

Pentz-Reckenzaun Meter.—This meter, which was shown by Mr. J. A. Pentz, of Philadelphia, is a highly interesting and novel one. It works entirely by gravity. It has two bars, each controlled by its own magnet. These bars fall by their own weight. They are brought back into position by means of a make-and-break contact, which is produced by means of a shunt circuit, and requires but one-fortieth of an ampere to set the bars in motion. The front bar runs at a fixed speed; the back bar, which is a permanent magnet, is controlled by the current and is accelerated or retarded in proportion to the amount of current flowing through the meter. It is quiescent until the first lamp is turned on, and ceases to work immediately after the last lamp is turned off. The meter has a plain dial upon which are five ordinary reading discs, showing the stage of current consumption. The machine is purely mechanical, is simple and accurate, can be easily transported, and may practically be set up anywhere. These meters are now on the market and are made to be operated by either direct or alternating currents. This meter is due to the combined efforts of Messrs. Anthony Reckenzaun and James A. Pentz, and is handled by a company at 1001 Chestnut street, Philadelphia, Pa.

President W. H. McKinlock, Mr. C. E. Brown and Mr. H. H. Small were present in the interests of the Central Electric Company. This popular supply house maintains a very successful St. Louis branch, the officials of which together with the officers and others of the home house lost no opportunities to sound the praises of the true and tried "Okonite" and their many other specialties. Mr. Geo. T. Manson, of the home office of the Okonite Company, was present at the convention in the interests of his company.

Ansonia Electric Company, or the Electrical Supply Company as it has been known favorably for years, continued its custom of having a host of representatives at the convention. General manager F. S. Terry, Messrs. D. E. Goe, Chas. E. Wirt and N. W. Wood, representing the heads of at least four departments of this popular house, were in attendance at the convention. It is needless to say the interests of the Ansonia Electric Company were well looked after.

The Falls Rivet & Machine Company.—Mr. E. L. Babcock, president of the above named company, and his son Charles represented their celebrated clutches at the Convention and were unceasing in their efforts to make things pleasant for their friends and customers of whom many were in attendance. Mr. Babcock left St. Louis with the justifiable elation due to having secured four handsome contracts while in St. Louis. Mr. Babcock's factory is working night and day to keep up with orders.

General Incandescent Arc Lamp Company.—The exhibit of the General Incandescent Arc Lamp Company was certainly a most interesting and novel one. This company are making a specialty of highly ornamental arc lamps for indoor and outdoor lighting. Some very exquisite designs were shown. The workmanship on these goods is so near perfection as to practically baffle competition. Mr. Gus. Noll was personally in charge of the exhibit, which attracted universal attention.

The Interior Conduit and Insulation Co., of New York, were represented by E. W. Little and Romaine Mace. They had a neat exhibit of their Lundell generators and motors in the smaller sizes, running fans, etc., off the circuits of the Electric Selector & Signal Co. They also distributed a very fine edition of their Architects' Electrical Bulletin, which contained 12 pages of illustrated matter relative to Interior Conduit and questions of wiring.

Alexander, Barney & Chapin were admirably represented by Mr. H. G. Issertel. The anniversary of the incorporation of the company was celebrated by Mr. Issertel in a neat way on Wednesday. In the morning, the gentlemen were given boutonnieres and in the evening the ladies were given beautiful bouquets to be worn at the Tesla lecture. It is needless to say that this floral tribute to brains and beauty was highly appreciated.

Fort Wayne Electric Company.—The parlors of the Fort Wayne Electric Company were practically besieged with interested ones looking at the new direct current arc lamp for incandescent circuits. A handsome working arc lamp for alternating currents was also in operation, a double and single carbon both being shown. Messrs. Morrison, Wood, Knight and several others connected with the company entertained magnificently.

Mr. W. D. Packard, of the New York & Ohio Company, makers of the justly celebrated Packard lamps renewed acquaintances made not only at the conventions of which he is always an enthusiastic attendant but with those who have come to know him through using his excellent lamps. Mr. Packard is going in for electric railroading enterprises in his spare time, at Warren.

The Chas. E. Gregory Co. of Chicago, represented by their principal, had on exhibition their wire tightening ceiling board, their insulated hanger for arc lamps, and their "Acorn" weatherproof switch. These and other novelties made a very neat and effective display.

Mr. W. J. Hammer visited St. Louis for the purpose of enjoying a professional holiday, and enjoyed it. He was the recipient of a great many congratulations on his William Wallace articles appearing recently in The Electrical Engineer. The *Electric Spark* of Chicago, circulated during the Convention, paid him the compliment of referring especially to these articles and of reproducing in miniature one or two of the more interesting cuts.

Mr. George Cutter, of Chicago, made a very tasteful display of his electrical supplies, including not only such well-known specialties as the Pattee lamp hour recorders, Cutler instruments, Pass & Seymour's porcelain wares, but a large variety of fine sockets, switches. etc. With him were Messrs. F. McMaster and H. L. Hadaway.

The E. G. Bernard Co., of Troy, N. Y., were represented by Mr. E. G. Bernard who exhibited the Powers arc light cut-out made by his concern. It has already been illustrated in these columns. It is a strong, neat piece of mechanism, thoroughly insulated with porcelain, and made with glass or metal face. Mr. Bernard also showed their new special safety porcelain cleat.

Harry P. Bishop, Chicago, representative of the Massachusetts Chemical Company, lost no chances to sound the praises of "Insullac." Mr. Bishop spent several days in the *Muddysippi* city previous to the opening of the Convention, and as a result it will not be long before all the prominent supply companies will be well stocked with this already famous insulating compound.

The Standard Underground Cable Co. were represented by Mr. J. W. Marsh, vice-president and general manager, and their Western sales agent, "Fred" E. Degenhardt, the only exhibit being in Mr. Degenhardt's words, "our natural propinsities." These are of course so well-known that it is unnecessary to enlarge on them.

The interests of the "oldest" electric supply house in New York were taken care of by Mr. Frank A. Magee. In short an Electric Light Convention without Frank Magee would be incomplete, and the affairs of The E. S. Greeley & Co. were safe in his hands.

Mr. Chas. E. Gregory, of the Chas. E. Gregory Company, who has secured the very desirable factory recently occupied by The Forée Bain Electric Company, in Chicago, was on hand. A circular descriptive of a most interesting line of specialties, more particularly in the interest of Central Station people, was distributed. Mr. Gregory's business is peculiarly one of his own as he maintains besides the above, a first-class exchange for everything electrical.

A very handsome exhibit was that of a 2 h. p. alternating motor, manufactured by the Wagner Electric Mfg. Co. This machine was located in the private office of the Missouri Electric Light Co., where it was viewed by many interested people.

Mather Electric Company.—Be it observed that the interests of the Mather Electric Company suffered not in the hands of Charlie Hill, and nearly every person was the recipient of one of the little souvenir screwdrivers. They made a hit.

Several Electrical Engineers of standing were present at the Convention, including Fremont Wilson, John A. Seely, F. W. Royce, A. H. Bauer (electrician Pullman Co.), and others.

A Pretty Little Souvenir of the Convention was that distributed by Mr. E. G. Bernard—a tasteful and costly card case, with four pockets, and bearing a gold inscription that signified its origin.

Mr. F. P. Little arrived in time to represent Chicago as well as Buffalo. The operations of his new company are becoming very extensive.

The General Electric Company were without exhibit, except the Convention itself, and were represented by Dr. Louis Bell, Mr. B. E. Sunny and Mr. J. J. Moore.

The Western Electric Company were represented by Col. G. L. Beetle and E. W. Goldsmith.

The Kester-Atwood Electric Co. of Chicago were represented by Mr. J. F. Kester. This company are putting on the market a desirable arc lamp for incandescent circuits.

Mr. Geo. C. Bailey, and Mr. A. B. Conover, General Sales Agent, for the West, had the interests of The John A. Roebling's Sons Co. in charge. A little bird whispered late Thursday p. m. that some nice business had been corralled.

The Standard Paint Company, makers of the famous P. & B. insulating compounds, were represented by their Western Manager, Mr. P. H. Hover.

The Madison Car Co.'s agent, Mr. Spencer Munson, was in St. Louis, and while not directly interested in the electric light business renewed many acquaintances around the Southern Hotel.

Taylor, Goodhue & Ames were represented by Mr. Wells Goodhue. A very handsome model of their Diamond transformer attracted a great deal of interest.

LIST OF ATTENDANTS AT THE ST. LOUIS CONVENTION.

Allegheny, Pa.—D. Hunter, Jr.

Altoona, Pa—W. H. Markland, E. B. Greene.

Anniston, Ala.—Howard W. Sexton.

Baltimore, Md.—H. C. Tudor.

Battle Creek, Mich.—J. B. Foote.

Beardstown, Ill.—W. E. McCullough.

Birmingham, Conn. Robert E. Wyant.

Boston, Mass.—Dr. Louis Bell, C. S. Haley, Chas. I. Hills, Geo. F. Talcott, H. H. Brooks, Capt. William Brophy, Benjamin Taft, J. H. Mason, Robert B. Tabor, Matt M. Merrit, Charles E. Bibber, Addison G. Sargent, D. F. Urquhart, W. S. Key.

Bridgeport, Conn.—W. C. Bryant, C. E. Carpenter.

Brooklyn, N. Y.—T. E. Crossman, James Ferguson, Frank C. Mason, E. F. Peck.

Buffalo, N. Y.—R. J. Getz, William C. Hodge, F. P. Little.

Camden, N. J.—Hon. E. A. Armstrong, Miss Elizabeth W. Armstrong, Miss Carrie W. Morgan, John J. Burleigh, Mrs. John J. Burleigh, Miss Retta Burleigh.

Canon City, Col.—H. B. Slater.

Carthage, Mo.—S. E. Whitehead, H. H. Harding

Carterville, Ill—F. C. Zimmerman.

Chanute, Kas.—William J. Bailey.

Chicago.—Geo. C. Bailey, W. D. Ball, Col. Geo. L. Beetle, C. E. Brown, M. J. Bulkley, E. W. Buss, Paul D. Cable, John R. Coffman, A. B. Conover, J. F. Conner, L. W. Collins, W. F. Collins, E. A Cummings, Geo. Cutter, F. R. Degenhardt, Fred DeLand, J. W Dickerson, F. E. Drake, S A. Douglas, Miss Annie E. Fortiner, E. W. Goldsmith, C. E. Gregory, Thomas M. Grier, D E Goe, Mrs. Moshier T. Greene, J. F. Kester, Ernest L Clark, Edward Stockwell, Wells Goodhue, C. E. Wilson, P. H. Hoover, H. S. Manning, W. C. McKinlock, W. H. McKinlock, Mrs. McKinlock, S. F. B Morse, J. A. Mosher, D H. Ogden, Miss Ogden, J. B. O'Hara, Chas. T. Page, E. L. Powers, D. P. Perry, F. L. Perry, G. L. Reimann, J. Scribner, E. F. Seixas, Geo. S. Searing, A. M. Searles, H. Small, Thos. S. Stacey, M. J. Sullivan, B. E. Sunny, J. H. Shay, F. S. Terry, T. Theberath, C. H. Wilson, Chas. E. Wirt, John Valentine, A. W. Harvey, M. M. Wood, H. I. Hadaway, James M. Kearney, C. H. Wilmerding.

Cincinnati.—P. A. Clisdell, George B. Edgar, C. E. Jones, Robb Mackie, R. J. Randolph, Chas. J. Foust, T. J. Ryan, R. S. Stearnes, John Turner, J. W. Wilshire.

Cleveland, O.—W. B. Cleveland, F. A. Lane, Fred A. Scheffler, L. B. Le Vake.

Cuyahoga Falls, O.—C. A. Babcock, R. S. Willard, E. L. Babcock, Mrs. Willard.

Colorado Springs, Col.—E. E. Wade.

Columbia, Mo.—William Shrader, M. L. Lipscomb.

Cedar Rapids, Ia.—W. J. Greene.

Davenport, Ia.—C. W. Grant, Mrs. Grant, G. E. McFarland.

Dayton, O.—W. H. Ashton.

Dallas, Tex.—D. M. Clower,

DeSoto, Mo.—J. D. Barth.

Denver, Col.—S. S. Campbell, Thomas H. Smith, P. H. Sterling, E. W. Rollins,

Des Moines, Ia.—C. K. Mead, Mrs. Mead, J. A. Colby.

Eau Claire, Wis—Frank S. Culver.

Evansville, Ind.—C. P. White.

Fayette, Mo.—A. P. Warren, T. Perry Smith.

Fort Wayne, Ind.—Chas. S. Bradley, C. S. Knight, W. C. Knight, James J. Wood.

Galesburg, Ill.—Edwin J. Larkin.

Hartford, Conn.—E. B. Hatch, C. E. Newton.

Houghton, Mich.—J. R. Dee.

Indianapolis, Ind.—A. D. Adams, C. D. Jenney, George C. Pyle.

Jacksonville, Ill.—M. P. Ayers, T. M. Doan.

Jackson, Mich.—W. A. Foote.

Janesville, Wis.—P. Norcross, Mrs. Norcross.

Jonesboro, Ind.—C. J. Butler.

Kenosha, Wis.—T. S. Boardman.

Kansas City, Mo.—Leo H. Gamp, A. M. Miller, G E. Claflin, Thomas F. Clohosey, W. T. Osborn, Geo. M. Myers and wife, G. A. Ross.

Kirksville, Mo.—J. B. Bragg.

Lockport, N. Y.—R. S. Bishop.

Louisville, Ky.—Campbell Scott.

London, Eng.—Prof. George Forbes, Vivian Hawkes.

Memphis, Tenn.—W. W. Carnes, Mr. Boardman.

Milwaukee, Wis.—S. G. Coleman.

Minneapolis, Minn.—Edwin S. Tice,

Montreal, Canada.—Albert J. Corroveau.

New Brunswick, N. J.—A. J. Jones,

New Britain, Conn.—L. C. Whitney.

New Orleans, La.—William Oswald, C. H. McFall

Nelsonville, O.—M. Poston.

Norwich, Conn.—George J. Jackson.

New York.—H. C. Adams, E. P. Atkinson, P. C. Ackerman C. O. Baker, Jr., A. H. Bauer, Louis Cassier, Mrs. Cassier, R. B. Corey, F. R. Colvin, B. E. Greene, H. M. Haines, W. J. Hammer, E. B. Hatch, M. M. Hayden, A. Mitchell Hall, Henry G. Issertel, George J. Jackson, W. J. Johnston, W. S. Key, J. C. Knight, A. B. Laurence, E. W. Little, Romaine Mace, Geo. T. Manson, Mrs. Manson, John J. Moore, F. A. Magee, J. D. Miller, P. W. Mitchell, T. C. Martin, H. C. Myers, J. P. McQuaide, Augustus Noll, W. F. Osborne, Nelson W. Perry, Geo. F. Porter, C. W. Price, H. T. Richards, John A. Seely, E. W. Seymour, C. D. Shain, C. E. Stump, H. J. Smith, H. M. Swetland, J. B Taltavall, Nikola Tesla, Herbert Laws Webb, B. R. Western, Fremont Wilson, E. E. Wood, W. T. Hunt, C. P. Mackie, J. C. Pierrez.

Newark, N. J.—R. O. Heinrichs, Wilson S. Howell, C. McIntire, Edward Weston.

Omaha, Neb.—M. J. Cowgill, F. J. Pearson,

Peru, Ind.—J. Horr.

Philadelphia.—C. A. Bragg, Miss Cumings, H. B. Cutter, A. J. DeCamp Mrs. DeCamp, Miss DeCamp, W S. Horry, H T. Paiste, A. H. Manwaring. Mrs. Manwaring, A. J. Martin, John K. Martin, James A. Pentz, T. Carpenter, Smith, E. Ward Wilkins,

Pittsburgh, Pa.—H. H. McDuffie, Alex. Jay Wurts, J. S. Crider, E. H. Heinrich, E. E. Little, G. H. Blaxter, L. B. Stillwell, F. Moore, H. McGonnigle, J. W. Marsh.

Pittsfield, Mass.—Henry Hine, John Hoover, A. Taylor, Calvert Townley

Racine, Wis.—P. H. Korst.

Ravenna, O.—C. L. Rodman.

Rensselaer, Ind.—W. B. Austin, Mrs. Austin.

Roodhouse, Ill.—E. H. Higbee, Jr.

Rolla, Mo.—A. L. McRae.

Rutland, Vt.—M. J. Francisco, Mrs. Francisco.

Rochester, N. Y.—G. A. Redman and wife, C. R. Barney, Mrs. J. N Quine.

Rockford, Ill.—M. A. Beal, Wm. E. Hinchliff, George Mayo, W. B. Roberts.

St. Louis.—Dr. Wellington Adams, T. N. Ambler, James I. Ayer, P. C. Burns, S. G. Booker, F A. Churchill, Jr., A. W. Dutton, H. Elliott, Jr., J. A, Ferguson, W. L Flower, J. F Gerleman, J. H. Hopkins, W. N. Matthews. Louis Nahm, Prof. Nipher, A. Partridge, P. N Rose, F. Schlosser, R. V. Scudder, George C. Stedman, A. C. Thompson, C. G. Woods, Capt. J. A. J. Shultz, C. H. Talmage, G. F. Durant, E. Ruebel.

Syracuse, N. Y.—W. J. Morrison, H. J. Goercke, E. T. Pardee.

Salem, O.—D. L. Davis,

Seattle, Wash—Dr. E. C. Kilbourne.

Sewickley, Pa.—E. P. Young.

St. Joseph, Mich.—W. Worth Bean.

Steubenville, O.—J. G. Gwynne, Thomas Johnson.

Stevens Point, Wis.—H. C. Craig.

St. Joseph, Mo.—J. F. Dyer, J. H. Parker.

St. Paul, Minn.—John A. Berkley.

Springfield, Ohio.—J. H. Miller,

Springfield, Mo.—Frank B. Smith.

Taylorville, Ill.—J. N. C. Shumway.

Telluride, Col.—P. N. Nunn.

Toledo, O.—John J. Moore.

Toronto, Ont.—J. H. Quinlan, Frederic Nichols.

Troy, N. Y.—E. G. Bernard.

Vandalia, Ill.—D. M. Clark, Anna M. Clark.

Vincennes, Ind.—H. W. Frund.

Washington, D. C.—F. W. Royce,

Washington Court House, O.—Jerome Penn.

Washington, Mo.—A. A. Tibbe.

Warren, O.—W. D. Packard.

Waterbury, Conn.—J. O. Crane.

Worcester, Mass.—H. H. Fairbanks.

Windsor, Conn.—M. E. Baird, A. D. Newton.

West Superior, Wis. A. A. Cross.

CONVENTION NOTES.

The Ladies attending the Convention were most charmingly entertained by the committee of St. Louis ladies. Not a moment was left open, but a continued round of pleasure was furnished. Receptions, theatre parties, carriage drives, which the beautiful weather fortunately permitted, etc., etc., were enjoyed. A ladies' luncheon was also given at the rooms of the Electric Club, in fact nothing that could be imagined to add to their pleasure was left undone. The ladies attending the convention were Mrs. J. Turner, Cincinnati; Mrs. C. J. Foust, Cincinnati; Miss A. E. Fortiner, Chicago; Mrs. A. H. Manwaring, Philadelphia; Mrs. Geo. T. Manson, Brooklyn; Mrs. L. A. Beebe, Hutchinson, Kan.; Mrs. G. A. Redman, Rochester; Mrs. J. H. Quine, Rochester; Mrs. G. N. Meyers, Kansas City; Mrs. A. J. DeCamp, Philadelphia; Miss DeCamp, Philadelphia; Miss Clara M. Cumings, Philadelphia; Mrs. W. E. Hinchliff, Rockford; Mrs. M. A. Beal, Rockford; Mrs. D. H. Ogden, Chicago; Mrs. M. A. Burleigh, Camden, N. J.; Mrs. J. J. Burleigh, Camden, N. J.; Miss E. W. Armstrong, Camden, N. J.; Miss C. W. Morgan, Camden, N. J.; Mrs. M. J. Francisco, Rutland, Vt.; Mrs. L. Cassier, Brooklyn; Mrs. C. W. Grant, Davenport, Iowa; Mrs. W. B. Austin, Rensselaer, Ind.; Mrs. W. H. McKinlock of Chicago accompanied by Mrs. Moshier T. Greene. The ladies' committee of reception were Mrs. J. I. Ayer, (who gave the ladies a most charming reception at her residence), Mrs. W. L. B. G. Allen, Mrs. T. N. Ambler, Mrs. Robt. McCullough, Mrs. John Segrist, Jr., Mrs. Geo. A. Rowley and Miss Rowley, Mrs. Henry O'Neil, Mrs. E. J. Bagnoll, the Misses Shultz, Miss Bantos.

The Convention Special Trains were great successes this year. The "Electrical Special" from New York left at noon on Sunday and picking up delegates all along its route, reached St. Louis at 7 p. m. on Monday, with about 100 passengers on board—the train being greeted 65 miles out by a reception committee detailed for the purpose. Thanks to the care and skill of Mr. C. O. Baker, Jr., Master of Transportation, and Mr. Haines, of the Pennsylvania Railroad Co., everything had been thought of and provided necessary to make the trip a success, and success it was. As much may be said of the Chicago Special, which left Chicago on Monday night, under the direction of Messrs. A. Scribner and F. S. Bishop, and which landed a party about 60 strong, on Tuesday morning. At East St. Louis the party were met by a reception committee with carriages, and landed at the hotel.

The Headquarters of the Association were temporarily established in one of the parlors of the Southern Hotel, but it was soon found convenient and desirable to remove them for permanent work to the new Bell Telephone Building, where Secretary Porter had his office going all the time, with the constant assistance of several members of the executive committee. The work of the Association has rarely excited so much attention in the city visited as it did in St. Louis, and hence the inquiries and requests for information were simply innumerable. The lecture by Mr. Tesla also threw a vast amount of extra work on the Secretary's office, owing to the extraordinary demand and pressure for tickets. But the office was never more efficiently conducted, and its management reflected great credit on Mr. Porter and his assistant Miss Billings.

The Meetings of the Association were held in what will ultimately be the operating "central" of the new Telephone Exchange Building, corner of Tenth and Olive streets. In spite of the distance from the hotel—at least half a mile—the sessions were very well attended. The hall was very handsomely decorated with red, white and blue festoons, crossed with orange. At the back of the stage were the stars and stripes, and over it were some very fine electroliers. Above the flag was an inscription: "Electricity; The Most Potent Force;" on the east wall was the word "Welcome," and on the west wall was the Missouri coat-of-arms. The effect was charming. As might be expected of Mr. George F. Durant, of the Telephone Company, everything possible was done to promote the comfort of the Association.

Mr. C. O. Baker, Jr., who has so often and so efficiently acted as Master of Transportation, was the recipient on Wednesday afternoon, in the ladies' parlor, of a beautiful silver punchbowl presented by the passengers on the Electrical Special from New York to St. Louis. The presentation took place about 5.30. The bowl was tendered to Mr. Baker in the name of the donors by Mr. T. C. Martin, who also read the address subsequently engrossed. Mr. Baker though rather taken by surprise, replied in a few neat and modest sentences and then the large party adjourned to an adjoining parlor to christen the bowl with champagne. A chased inscription around the rim of the bowl gave the story of its presentation.

The Electrical Club of St. Louis did itself proud. Its hospitality was of the most generous nature, and was without any congnizance of hours and seasons. The club has richly appointed rooms in the Equitable Building, and these were decorated for the occasion. A luncheon was on service all the time. The members and officers of the Club were in constant attendance, and were unremitting in their attentions to visitors. The Club was, in fact, the centre of the convention activities of the week.

Central Stations were the main objects of interest on Tuesday evening, and in a procession of about 40 carriages, the members left the Electric Club, at 8 o'clock, and were escorted to the Missouri Electric Light and Power Station, the Municipal Light and Power Station, and the Union Depot Railway power house. The trip was exeedingly enjoyable, and many points of value and interest were elicited.

Secretary George F. Porter was made very happy and rendered positively speechless before the close of the convention by the presentation of a beautiful gold watch. Mr. Porter has a most disagreeable habit of always wanting to have things ready two or three days in advance, and it was thought that this gift might bring him to time; instead of which it knocked him out.

TELEPHONIC TRANSMISSION OF MUSIC BETWEEN NEW YORK AND CHICAGO.

The possibilities which the future holds out for the transmission of music to long distances by means of the telephone are not being lost sight of, and a most interesting test designed to show the capacity of the Chicago-New York Telephone Line for this purpose was recently undertaken by the Long Distance Telephone Company. In order to obtain a competent judgment as to the quality of transmission, arrangements were made with Mr. Theodore Thomas, the well-known musical director, of Chicago, to listen at that end of the line.

On the afternoon of February 27th a number of musical critics gathered at the New York office of the Long Distance Company, No. 18 Cortlandt street, where a Steinway Grand piano was placed, the sound waves being led to the long distance transmitter by a large funnel. Miss Minnie Wetzler, piano soloist of the Boston Symphony Orchestra, played a number of selections, and Mr. Plunket Greene, the basso, sang a number of songs. Mr. Thomas expressed himself as more than pleased with the results of the test, and went even so far as to say that the results obtained over the Chicago line were better than those which he had heard on previous occasions in the East over very much shorter lines.

There can be little doubt that, if properly exploited, long distance concerts can be made a commercial success, which may add not a little to the revenue of the Long Distance Company.

THE SOUTH LONDON ELECTRIC RAILWAY.

In a recent paper read before the London Society of Civil Engineers, Dr. E. Hopkinson gave a number of most interesting figures on the operation of the South London underground electric railway. The engines average 230 indicated horse power each, or only one-half of full load; and they consumed 27¼ pounds of steam per indicated h. p. hour, as compared with 22 pounds at half load, obtained with Willans high-speed engines. The combined efficiency of engine and dynamo is 78 per cent. at full, 70 per cent. at half load, and 65 per cent. at quarter load. They consume 8.04 pounds of North Country coal per Board of Trade unit. With average load the loss in long feeders is 5.7 per cent., and in distributors 3.5 per cent., a total of 9.2 per cent., say 10 per cent., equal to 1¼ tons of coal per day, which exactly comes to the interest on £7,000—the actual cost of conductors. The coal burnt is 35 to 40 tons a day. The electrical efficiency of the system over all is 62 per cent., and the average efficiency of of locomotive 70 per cent. The total cost of running is 5.1d. per train mile without wages, as against 6.3d., the total guaranteed cost, or less by 20 per cent. than the guarantee, and this though the trains are 30 per cent. heavier. In additional tables the details of cost to December 31, 1892, were given: Train mileage, 214,417; number of passengers, 3,317,602. Cost of generator station working, including renewals and repairs: wages, 1.12d.; fuel, 2.42d.; water and gas, 0.28d.; oil and stores, 0.41d.; repairs, 0.36d.; a total of 4.59d. per train mile, or equal to 1.56d. per Board of Trade unit. The cost of locomotive working, including repairs, was: generating station, as above, 4.59d.; wages, 1.98d.; oil and stores, 0.10d.; repairs, 0.23d.; total, 6.90d. per train mile. The figure 1.56d. per B. T. unit will interest central-station engineers, as it is the lowest of any generating station, save Bradford, which generates at 1.41d. per trade unit, but using cheaper coal; at Pall-Mall the cost is 2.26d. Dr. Hopkinson justifies the use of jockey pulleys, mathematically showing that, when the speed of displacement traveling by wave motion forward is exactly equal to the speed of belt, there is very little loss by friction; and this condition is secured with a link belt running at 3,500 feet per minute, with a tension of 1,600 pounds, and weighing eight pounds per lineal foot. As to use of locomotive, the weight is four tons of frame and six tons of motor; the motors, if separate, would have to be heavier in total, and the car frames would have to be made heavier—there might be a saving of two tons, 1 per cent. or 2 per cent., an advantage, thought Dr. Hopkinson, greatly outweighed by having the motors on one vehicle.

CUTLER & HAMMER.

Chicago is to have a new factory for high grade electric specialty and repair work. Cutler & Hammer is the name of the new firm, both of whose members are well and favorably known to the electrical trade in the west.

Mr. H. H. Cutler has had an experience of over eight years in central station work and may perhaps be better known to the trade as the inventor of the Cutler hot wire measuring instruments. Mr. E. W. Hammer has had a wide experience in all branches of high-class electrical manufacturing and has been for sometime general manager of the Chicago Electrical Manufacturing Company.

The new firm will make a specialty of all kinds of electrical testing and calibrating. They have a storage battery capacity of 1,000 amperes and 300 volts, as well as a most complete set of standard testing instruments. The factory is already well equipped for this kind of work. The officers of the new firm are at 313 Canal street, Chicago.

THE FIRST TELEPHONE "GUN."

The Shaver Corporation, of No. 1 Broadway, announces that it and its thirty or more sub-companies are preparing to enter the Electrical Telephone field promptly after March 7th. The sub-companies at McKeesport, Pa., have completed their exchange of about 100 subscribers and will open for business March 8th. This exchange is fitted with the Shaver duplex magneto telephones and the Utica Fire Alarm Telegraph Co.'s magnetos, switches and central office apparatus, thus claiming to avoid all the detail patents of the Bell Co. for exchange apparatus. The Shaver Corporation has a capital of $2,000,000, and some 50 prominent stockholders. The officers of the company are: President, Wm. H. Curtiss, private secretary of Wm. Rockefeller; Treasurer, Henry S. Iselin of the well-known family of bankers; Vice President and General Manager, George F. Shaver; Secretary, A. Emerson Shaver. This company seems determined to inaugurate a lively competition with the Bell Co. The Shaver Corporation offer protection to their sub-companies against litigation by bond.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

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NOTES ON LIGHTNING PROTECTION.

BY

Alexander Jay Wurts.

CENTRAL station men have not, as a rule, any very clear or correct ideas regarding the problem of lightning protection. A certain make of lightning arrester is purchased, one terminal of which is connected to the line, the other to the ground; then, if an armature or converter is damaged by a discharge the arrester is at once condemned. As a matter of fact, however, the party who installs the arrester is more often to blame in not following closely the instructions sent with the apparatus.

Lightning arresters as they are now constructed usually consist of a simple spark gap, in connection with some form of automatic circuit-interrupting device. As a circuit interrupter the apparatus can be easily tested by connecting the arrester across the terminals of a generator and in series with a switch; then, by bridging the spark-gap with a crumb of tin foil and throwing the switch a short circuit will be established, which if satisfactorily interrupted and if the test can be indefinitely repeated, well and good, but if not, the arrester, as an automatic device, can be properly rejected. However, the circuit interrupter is in a sense little more than a labor saving device and does not bear directly on the efficiency of the apparatus as a lightning protector. The feature of a lightning arrester pure and simple is the spark-gap, and this should provide a path to earth for the discharge, which shall offer less resistance to its passage than the insulation in any part of the system. It is desirable therefore that the spark gap be small; in other words, that it shall break down with an electric strain considerably less than the breaking-down E. M. F. of the armature or converter insulation. But even with a very small spark-gap an arrester may often fail to take the discharge. There are several reasons for this, which we will now consider under the following heads:

1. The leads to and from the arrester. 2. The ground connection. 3. Nodal points.

Leads to and from the Arrester.—It is well known that discharges, such as occur across the spark-gap of an arrester, are oscillatory in character; that is, they have the properties of an alternating current of very high frequency and consequently meet an enormous resistance when forced to pass through a coil of wire. For example, discharges of this kind will often jump two or three inches of air space rather than pass through only a few turns of large copper wire. Even long, straight wires offer considerable resistance to these discharges, so that if the leads to or from a lightning arrester are long or crooked, or both, the resistance of the spark-gap forms but a small fraction of the total resistance included in the discharge circuit.

Lightning arrester connections are commonly made with odd lengths of wire lying about the station, and if a little too long (it is perhaps a pity to cut them) the extra length is neatly coiled around a broom handle or convenient gas pipe, and thus unwittingly an enormous resistance is connected in series with the arrester. The writer has repeatedly noticed just such coils in lightning arrester connections, and on asking for an explanation it was usually suggested that they make a rather neat appearance. Frequently these wires are given a turn or two around porcelain insulators and sharp turns are made according to the fancy of the wireman. Not infrequently the ground wire will be led some considerable distance outside and away from the station to a water pipe, well, or stream of water, the object being excellent, but the method poor.

The spark-gap arrester works to advantage only when intelligently installed. When possible the line to be protected should be led down and close to that which is to form the ground plate of the arrester; in other words, the charge should be forcibly led as near to the ground plate as possible before being discharged into the discharge circuit. If this plan were followed out the leads to and from the arrester could not be other than short and straight. No. 4 wire will be found sufficiently large for all lightning arrester connections. The joints should be carefully soldered.

Ground Connection:—It will hardly be necessary to mention that a good ground is one of the essentials of efficient lightning protection. In ordinary cases common sense will indicate the proper course to pursue, but out on the line the best results are not always easily obtained. In one instance, familiar to the writer, the ground wires from several line arresters were simply pushed down into the earth, and after several converters had been punctured the arresters were condemned as offering no protection whatever.

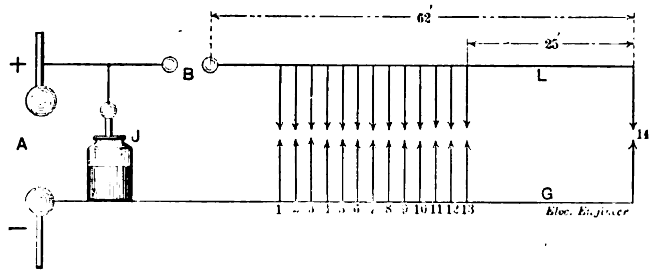
In central stations the best and usually most convenient ground is the water main. If this be not close at hand the line to be protected should be run as near to it as possible and then careful connections should be made from the arrester to this main. It may often be convenient to run a branch water pipe direct to the ground terminal of the arrester.

If this method is not practicable a deep hole should be sunk directly under the arrester and a copper plate having an area of not less than 50 square feet, buried in it. The ground terminal of the arrester should be soldered to this plate and the hole filled in solidly with fine coke. The thickness of the plate is not important as far as ground connection is concerned, but it should be thick enough to be lasting, say, $\frac{1}{8}$ of an inch. The depth of the hole should be such as to insure permanent dampness.

For line arresters even the above method will not always be convenient. The following, however, is considered an excellent substitute: Dig a hole directly under the arrester about two feet in diameter and deep enough to reach damp earth. From this point down drive 6 or 8 feet of (pointed) gas pipe, in the upper end of which screw a solid brass plug, and to this plug solder the ground wire of the arrester. In this case the lower portion of the ground wire should consist of about 100 feet of bare wire formed into a loose coil, the convolutions of which should be evenly distributed throughout the depth of the hole and the latter then filled in solidly with fine coke. In this manner advantage is taken of the deep, damp earth and surface drainage as well. In some instances it may be desirable to conceal or protect the ground wire between the arrester and earth. For this purpose an ordinary gas pipe will offer a good protection and at the same time serve to decrease the resistance of the discharge circuit even though the pipe be thoroughly insulated from the wire.

Nodal Points:—It is now well known that disruptive discharges form nodal or neutral points along the line and that at these points there will be little or no tendency to discharge. If a single arrester be connected to the line it may, or may not, discharge, according to circumstances ; a certain discharge may take place across the arrester, or it may pierce the insulation of an armature, or it may even do both at the same time. In fact these nodal points are not fixed but are constantly changing their positions. This part of our subject can be better illustrated by referring to the accompanying diagram, Fig. 1.

Let A represent the terminals of an influence machine ; J a powerful battery of Leyden jars ; B a large spark-gap; L is a wire which may represent a trolley line ; G a second wire which may represent the ground ; 1, 2, 3, etc., up to 13 are $\frac{5}{32}$-inch spark-gaps placed 12 inches apart and connected between wires L and G. These may represent as many lightning arresters connected to the line. The connections and distances are all clearly indicated. If now the influence machine A be set in motion the battery J will become heavily charged, till finally a violent disruptive discharge will occur at B, and thus suddenly charge the line L with a different potential from line G, so that there will now be a tendency for a disruptive discharge to take place between lines L and G, and in fact this discharge will pass at one or more of the spark-gaps 1, 2, 3, etc. These discharges occur in a great variety of ways, the following being a few examples : A single brilliant spark may pass at any one of the first ten gaps. Two, three and occasionally four simultaneous sparks, variously located, will pass between one and ten ; sometimes these occur at successive gaps, but they are more often scattered. In some instances the discharges are of equal brilliancy, in others one of two intense sparks would pass one or two gaps together with a much fainter discharge or scarcely perceptible spit at any of the other gaps included in the first ten. A discharge never occurs across any of the last three gaps. Four of the first 10 gaps are then increased to $\frac{10}{32}$ inch with the result that the discharge frequently selects one of these larger gaps in preference to any of the others. Occasionally, however, sparks will jump one of the larger gaps together with one or two of the smaller ones, and so an indefinite number of combinations can be produced with results emphatically demonstrating that with several spark-gaps there is no certainty that the discharge will take place across any particular one of them.



AN EXPERIMENT IN LIGHTNING PROTECTION.

A $\frac{5}{32}$-inch gap is now connected at 14 and with every discharge at any one of the first ten gaps a faint, threadlike spark will pass at 14. It can hardly be called a disruptive discharge and is not of a character likely to do damage. This minute spark is due to what Dr. Lodge calls the "recoil kick," that is, the electric waves strike the ends of the wire and recoil with increased intensity. When the gap at 14 is increased these threadlike sparks become less and less frequent, till finally when the gap equals $\frac{17}{32}$ inch they cease altogether. However, when only 1 and 14 are connected to the lines brilliant discharges frequently occur at either one or the other, or at both.

Now, assuming that the above conditions and results correspond in many respects to those found in actual practice, the lesson to be learned is a simple one : Electric light and power circuits should be provided with spark-gap lightning arresters at frequent intervals along the line. Two or three to the mile would seem to be sufficient in a majority of cases; in others a fewer number might suffice. A spark gap arrester should certainly be connected at either end of each line. An electric circuit well equipped with properly constructed line arresters should have little to fear from disruptive discharges.

Summary:—Follow the instructions sent with the arrester. Test the automatic circuit interrupting device. Make the leads short and straight. Make the ground connection of the very best, and avoid nodal points by using a large number of line arresters.

AN AMPERE FOOT TABLE.

BY

G. T. Evans.

THOUGH wiring tables in electrical literature are already as thick as pie recipes in New England cook books, and an addition to the number cannot altogether be a novelty if it may not seem superfluous, I still believe the table here appended has some points in its favor. It is the result of a need for a concise and comprehensive "bureau of information," adaptable to the majority of problems met with in estimating sizes, weights, etc., of wires in contracting and construction work.

In this table all determinations are made for "double" feet, so that in estimating weight and length of series, the distance from point of supply to point of distribution, and not the total length of circuit need be observed; as the table gives the maximum capacity in "ampere feet" for various losses in volts, it is not restricted to any particular E. M. F. or lamps, motors or any other transforming device. As is well known from the experiments of Dr. Matthiessen, the constant 21.4 is the area in circular mils of one double foot of commercially pure copper having a resistance of one ohm at a temperature of about 59° F. Such a wire with a fall of one volt along its length would be traversed by one ampere. To double this current, twice the fall in voltage would be necessary ; likewise to double the length of circuit and pressure, a flow of one ampere would require the same increase in volts, so that it is apparent that considering the factors of the unit "ampere foot" simply as numerics, they are equal in value, and 1,000 ampere feet, for instance, would cause the same voltage loss whether the feet = 1,000 and the amperes = 1, or vice versa, the same size of wire being used in each case.

Of course it is obvious that increased resistance due to heat caused by flow of current is not taken into account in the above, and in general examples it need not be. The only check necessary to excessive amperage on a wire is its safe carrying capacity. Two determinations of these limits are given in the table. One of these, for insulated wires encased in moulding, is from experiments made by Mr. A. E. Kennelly, and the other, for exposed insulated wires, is that adopted by the Board of Fire Underwriters of Alleghany Co., Pa.

The variations of volt losses in the table are sufficiently numerous for most work ; but they may be greatly increased, if desired. The "Maximum Ampere Feet" for a loss of one volt on a certain sized wire will become that for a loss of .1 volt by inserting a decimal point, or that for 100 volts by adding two ciphers. In fact the maximum ampere feet for any loss on any sized wire may be found by

	SIZE OF WIRE—B. & S. GAUGE.	18.	17.	16.	15.	14.	13.	12.	11.	10.	9.	8.	7.	6.	5.	4.	3.	2.	1.	0.	2/0	3/0	4/0
Total Pounds Wire per foot of Transmission Distance.	Standard Underground Cable Co.'s "Sterling"	......	......	......	......	......	......	......	......	......	......	.128	.17	.196	.24	.288	.364	.45	.55	.68	.9	1.12	1.39
	S. U. C. Co.'s "Standard"	.032	....	.036	......	.050	......	.064	.074	09	.116	.136	.188	.218	.26	.32	.396	.496	.62	.75	.96	1.188	1.436
	S. U. C. Co.'s "Tip Top"	.036	......	.042	......	.056	......	.072	.084	.1	.126	.148	.204	.234	.276	.34	.42	.524	.656	.784	1.	1.230	1.48
	A. E. Moore's "Weatherproof"	.02	......	.025	......	.038	......	.052	......	.09	.102	.132	.154	.194	.238	.294	.36	.448	.540	.664	.846	1.074	1.46
	Holmes, Booth & Hayden's "K. K."	.025	......	.033	.....	.043	......	.062	.079	.....	.109	.145	.165	.216	.258	.314	.396	.484	.614	.726	.888	1.098	1.6
	Ansonia Electric Co.'s "Shield Brand," "Regular"	.022	......	.026	......	.042	......	.064	......	098	......	.168	.....	.228	.268	.326	.384	.484	.614	.792	.968	1.244	1.496
	Ansonia Electric Co.'s "Shield Brand" "Special"	......	......	......	......	......	......	......	......	......	......	.19	......	.25	.288	.35	.406	.512	.648	.842	1 022	1.32	1.568
	Ansonia Electric Co.'s "P. & B."	.016	......	.024	......	.038	......	.054	......	.09	......	:13	.156	.19	.234	.286	.356	.446	.564	.718	.918	1.18	1.416
	" Underwriters"	.024	.....	.028	......	.042	......	.070	......	.108	.114	.148	......	.218	.272	.334	.390	.482	.606	.752	.984	1.12	1.5
	Edison "Grade One"	.0229	.0276	.0339	.0403	.0483	.058	.0695	.08238	.097	.1158	.1389	.1676	.2035	.2478	.3044	.393	.4917	.6153	.7702	.986	1.2068	1.507
	Edison "Tree"	.0279	.0335	.0409	.0482	.057	.068	.0809	.0933	.1116	.1315	.1562	.1867	.2246	.2719	.3305	.428	.5357	.6694	.8354	1.0532	1.3196	1.6468
	Bare Copper	.0098	.0123	.0156	0196	.0248	.0313	.03946	.04976	.06274	.0791	.0997	.1258	.1586	.200	.2562	.318	.4009	.5057	.638	.8041	1.014	1.278
	Roebling's Weatherproof "Double"	.0215	024	.028	.034	.041	.052	.060	.074	.088	.10 6	.128	.15 4	.18 6	.230	.282	.356	.440	.548	.684	.852	1.074	1.342
	Roebling's Weatherproof "Triple"	.024	.027	.032	.040	.048	.060	.070	.086	.104	.130	.164	.190	.212	.280	.308	.400	.500	.588	.780	.956	1.1 8	1.4 7
	N. Y. Insulated Wire Co., "Competition" Line Wire	......	......	......	......	......	......	......	......	......	......	.184	. ..	.222	.284	.362	.420	.570	.666	.800	......	......	......
	Safe Amperes, Open Wires	10	14	15	18	22	26	30	33	40	53	60	67	80	90	100	115	135	160	190	215	245	300
	Safe Amperes, Encased Wires	4.0	5.5	6.0	7.25	9.0	10.5	12	15	18	22	25	30	36	43	52	61	73	87	103	124	147	174
	Circular Mils	1624.3	2048.2	2582.9	3256.7	4106.8	5178.4	6529.9	8234	10381	13594	16509	20816	26250.5	33102	41742	52634	66373	83694.2	105592.5	133079.4	167805	211600

	SIZE OF WIRE—B. & S. GAUGE.	18.	17.	16.	15	14.	13.	12.	11.	10.	9.	8.	7.	6.	5.	4.	3.	2.	1.	0.	2/0.	3/0.	4/0.
LOSS IN VOLTS.	1	76	95	121	152	191	242	305	384	485	635	771	973	1227	1547	1950	2459	3101	3906	4934	6218	7841	9888
	1.5	114	143	181	228	286	363	458	576	728	953	1157	1459	1840	2320	2925	3689	4652	5859	7403	9328	11762	14832
	2	152	191	241	304	382	484	610	768	970	1270	1543	1945	2453	3094	3901	4919	6203	7813	9868	12437	15683	19776
	2.5	190	238	302	380	477	605	763	971	1213	1598	1919	2432	3066	3877	4876	6149	7753	9766	12335	15546	19603	24719
	3	228	286	362	456	573	726	915	1153	1455	1906	2314	2918	3680	4640	5851	7378	9304	13303	14803	18656	23524	29662
	3.5	266	334	422	532	667	847	1068	1345	1698	2213	2700	3404	4293	5414	6827	8608	10855	13672	17270	21765	26444	34607
	4	304	382	483	608	764	968	1220	1527	1940	2541	3086	3891	4906	6187	7802	9838	12406	15625	19737	24874	31365	39551
	4.5	341	429	543	684	859	1089	1373	1729	2183	2858	3471	4377	5520	6965	8777	11068	13956	17578	22204	27984	35286	44495
	5	379	477	603	761	955	1210	1526	1921	2425	3176	3857	4863	6133	7734	9752	12297	15507	19531	24671	31093	39206	49439
	5.5	417	527	664	837	1050	1331	1678	2113	2668	3494	4243	5350	6746	8507	10728	13527	17058	21485	27138	34202	43128	54823
	6	455	572	724	913	1146	1452	1831	2306	2910	3811	4629	5836	7360	9281	11703	14757	18608	23438	29605	37312	47048	59327
	6 5	493	620	784	989	1241	1573	1983	2498	3153	4129	5014	6413	7973	10054	12678	15987	20159	25391	32072	40420	50968	64271
	7	531	668	845	1065	1337	1694	2136	2690	3396	4447	5399	6709	8586	10828	13653	17216	21710	27344	34539	43570	54889	69215
	7.5	564	715	905	1141	1432	1815	2288	2882	3638	4763	5786	7295	9199	11601	14628	18446	23260	29297	37006	46639	58810	74158
	8	607	763	965	1217	1528	1436	2441	3074	3881	5082	6171	7782	9813	12374	15604	19676	24811	31250	39474	49749	61730	79102
	8.5	645	811	1026	1293	1623	2057	2594	3266	4123	5399	6557	8168	10426	13148	16579	20906	26362	33203	41941	52858	66651	84046
	9	683	859	1086	1369	1719	2178	2746	3459	4366	5717	6943	8754	11039	13921	17554	22135	27913	35157	44408	55967	70572	88990
	9.5	721	906	1146	1445	1814	2298	2898	3451	4608	6035	7329	9241	11653	14695	18530	23365	29463	37110	46875	59077	74492	93934

Maximum Ampere Feet.

An Ampere-Foot Table for Calculating Sizes, Weights, Etc., of Line Wires.—Compiled by G. T. Evans.

multiplying the "Maximum ampere feet" for loss of one volt for same sized wire by number of volts to be lost.

The part of the table giving weights per double foot of some of the insulated wires sold by the pound will be convenient. These have been computed from figures furnished by the several companies and are thought to be approximately correct. An allowance for waste and sag should always, of course, be made. This evidently will vary with the distance and variety of work to be done.

A few examples will illustrate how the table may be used:

(1.) A contractor wishes to carry current for 100 lamps, each lamp taking one ampere, a distance of 100 feet, using wire concealed in moulding. Ten volts is the limit of loss. Can he do it?

One hundred lamps each taking 1 (ampere) × 100 (feet) = 10,000 (ampere feet). With a loss of 10 volts a wire between the sizes Nos. 7 and 6 could be used; but the safe carrying capacity of the larger of these wires is but 36 amperes, so it is evident that 100 amperes could not be transmitted with 10 volts loss and be safe.

(2.) An engineer while inspecting a plant finds a line of No. 6 wire 1,000 feet long supplying 10—1 ampere lamps. He wishes to know the loss. 10 × 100 = 10,000 (ampere feet). Following down the column for No. 6 wire, 10,426 ampere feet is found, which is the maximum ampere feet for a drop of 8.5 volts.

(3.) A line is to be run from an electric station to feed a 200-light transformer 10,000 feet distant. The drop on line is not to exceed 100 volts; the ratio of transformation is one to 40; the lamps require ½ ampere each. What size wire is to be used, supposing the transformer is without loss? We have:

Total amperes on primary line =

$\frac{100}{40} = \frac{5}{2}$; $\frac{5}{2} \times 10{,}000 = 25{,}000$ ampere feet. A wire between the sizes Nos. 13 and 12 will answer the purpose, or practically, a No. 12 wire.

(4.) If the wire in the above was specified "K K" what would be the weight, making no allowance for sag?

Weight of 1 double foot = .062 lb.; 10,000 × .062 = 620 pounds.

5. There is a motor which is designed to have a pressure of 500 volts at its brushes. It is 2,000 feet from supply; it is of 20 h. p. and its efficiency is 80 per cent; a loss of 50 volts is allowed. What size wire is needed?

$$\text{Ampere feet} = \frac{\text{horse-power} \times 746 \times \text{distance}}{\text{volts} \times \text{efficiency}} =$$

$\frac{20 \times 746 \times 2{,}000}{500 \times .80} = 74{,}600$ ampere feet, which, with a loss of 50 volts will require a No. 5 wire.

6. Twenty-five amperes are to be distributed at a point 10,000 feet from dynamo. The pressure at dynamo is 1,111 volts and a loss of 10 per cent. or 111 volts is allowed. Five hundred feet of the distance is to be wired with scrap No. 2. What size wire shall be used for the rest of the distance?

Ans.—500 × 25 = 12,500 ampere feet. Using No. 2 wire for the conductor a loss of about 4 volts will be sustained. Total ampere feet = 250,000, less 12,500 = 237,500 ampere feet. 111 volts less 4 = 107 volts. 237,500 ampere feet with a loss of 107 volts will require a conductor of No. 3 wire, approximately.

7. A contractor to complete a job finds he has one more circuit to run. The pressure at dynamo is 1,000 volts, the distance is 3,000 feet; number of amperes, 20; loss 10 per cent., or 100 volts. He has a supply of both Nos. 12 and 4/0 wire on hand but learns that neither will do used alone, for, while No. 12 will give an excessive loss, No. 4/0 will be unreasonably expensive. How much of each shall he use? By the formula,

$$\text{FT} = \frac{\dfrac{(\text{R} - \text{M}_s)\ \text{M}_1}{(\text{R} - \text{M}_s) + (\text{M}_1 - \text{R})}}{\text{amp.}}$$

Where FT_1 = distance in feet covered by large wire.
" R = required ampere feet.
" M_1 = maximum ampere feet for large wire with given loss.
" M_s = maximum ampere feet for small wire with given loss.
" amp. = amperes.

And substituting the figures of the problem he obtains:

$$\text{FT}_1 = \frac{\left[\dfrac{(60{,}000 - 30{,}500)\ 988{,}800}{(60{,}000 - 30{,}500) + (988{,}800 - 60{,}000)}\right]}{20} =$$

1521.9 feet; and the length to be covered by the small wire 3,000 — 1521.9 = 1478.1 feet.

8. On a carriage driveway illuminated by electric lights is a 50 volt converter, to which is connected a No. 10 wire 200 feet long. On this wire, 10 feet from the converter is a lamp taking 3 amperes; at 20 feet, a lamp taking 10 amperes; at 40 feet, a bank of lamps taking 20 amperes, and at the end, 200 feet, a lamp which uses 1 ampere. What is the pressure at this lamp?

10 feet × 3 amp. = 30 amp. feet.
20 " × 10 " = 200 "
40 " × 20 " = 800 "
200 " × 1 " = 200 "
1,230 = total amp. feet = a loss of about 2.5 volts at last lamp.

9. In a certain town where the pressure at dynamo is 1,200 volts, a main circuit is stretched 3,000 feet on the principal street. A feeder is to be run from the electric station 4,000 feet away to tap on the main at the centre of distribution. The street through which this feeder is to pass intersects the principal street 200 feet from the end of the main line which is designated B. The main is tapped for current as follows: at B, 20 amperes; at 40 feet from B, 30 amperes; at 100 feet, 10 amperes; at 600 feet, 30 amperes; at 2,500 feet, 10 amperes; at 3,000 feet, 50 amperes. What will be the length and size of feeder and its weight if Standard Underground Cable Co.'s "Tip Top" is used, if a loss of 100 volts is permitted?

Centre of distribution, by formula:

$$\frac{\text{Sum of ampere feet}}{\text{Sum of amperes}} = 1301.3 \text{ feet from B.}$$

Feeder is tapped on main at this point = 1301.3 — 200 = 1101.3 feet from intersecting street. Total length of feeder is then 1101.3 + 4,000 = 5101.3 feet; number of amperes = 150; ampere feet = 765,195. At a drop of 100 volts a wire approximately No. 3/0 will be required. "Tip Top" = 1.23 pounds per foot; total weight will then be 6,274.59 pounds.

BLACKENING OF INCANDESCENT LAMPS.

According to M. A. Bainville in the *Revue Industrielle*, the presence of mercury vapor in lamp bulbs is insufficient to account for the blackening.

The lamp bulbs, as placed on the market, he maintains, contain a certain amount of oxygen, due either to the imperfect vacuum in the bulbs, or the pressure of water vapor, or coming possibly from the lamp filament itself. This occluded oxygen combines with some of the carbon of the filament, forming carbonic oxide, and this gas coming in contact with the relatively cool surfaces of the glass bulb undergoes dissociation, the carbon being deposited on the glass and the oxygen being set free to again combine with new carbon molecules of the filament. This operation, he argues, goes on constantly while the lamp is burning. The blackening process is most vigorous during the early life of a lamp, since at that time the condensing surfaces of the glass bulb are most efficient. After the first deposit of carbon the operation goes on more slowly.

THE BROWN SINGLE PHASE ALTERNATING CURRENT MOTOR.

BY

C. E. L. Brown

In the belief that it may be of some interest to the readers of The Electrical Engineer, I submit the two accompanying illustrations showing two of my single-phase motors in actual work.

The smaller one, Fig. 1, is the motor described in my article[1], and will develop up to as much as 6 h. p. with a very high efficiency, as may be judged from the fact that the motor, although its total weight is only 330 lbs., will give this output without undue heating. The motor drives a line of shafting in our works; the man standing beside it is of medium height and gives an idea of its size. In the background may be seen a group of water cells, half of which give an ample capacity for starting this motor. In this connection I may, perhaps, remark that I have other methods of starting such motors which are even simpler than those described, but which are not yet ready for publication.

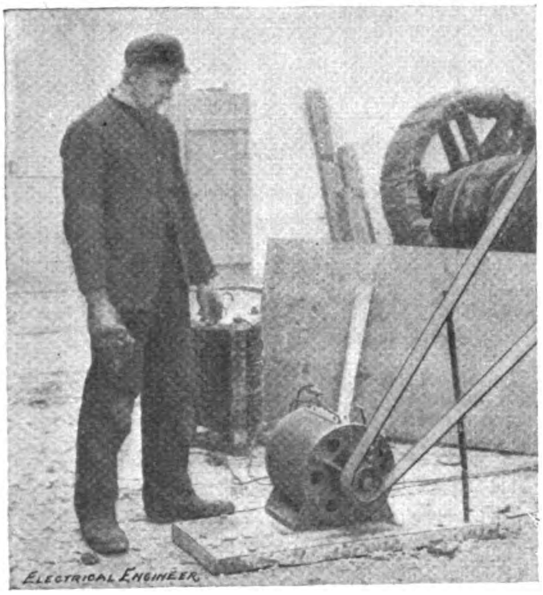


Fig. 1.—Brown 6 H. P. Single Phase Alternating Motor.

In the engraving, Fig. 2 a single-phase self-starting motor is shown which will give from 12 to 15 h. p. at a speed of only 800 revolutions per minute. Its weight is only 1,150 lbs. The photograph was taken while the motor was driving the main shaft in our heavy lathe shop. It has self-lubricating bearings suitable for continuous running without attention. Indeed, it may easily be run for many days together without being once looked at.

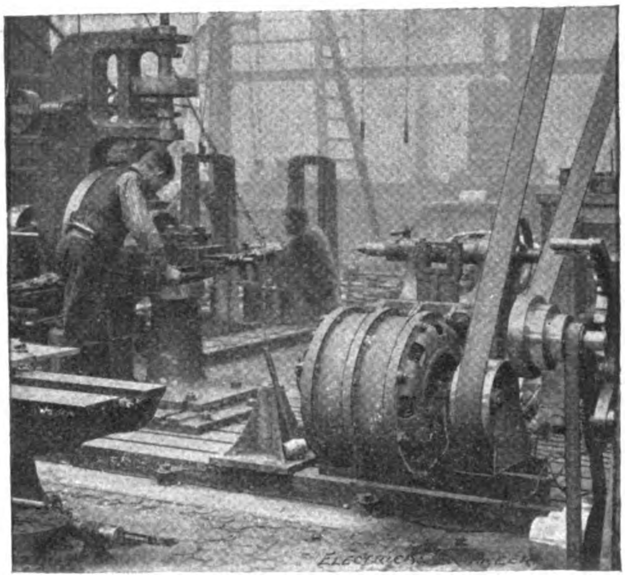


Fig. 2.—Brown 15 H. P. Single Phase Alternating Motor.

It may also be of interest to note that in a month or two we shall have these motors to the extent of over 100 h. p. actually running, ranging in size from $\frac{1}{4}$ h. p. to over 20 h. p.

HOW IT ALL HAPPENED.

The governor of the electric light works in Sedalia, Mo., broke the other night and the engine jumped from 500 to 2,000 volts. The globes burst in the street cars and there was great excitement for awhile.—*Daily Paper.*

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[1] The Electrical Engineer, Feb. 8, 1893.

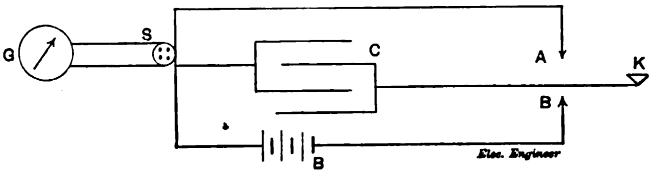
AN EASY METHOD OF CONTROLLING THE BALLISTIC GALVANOMETER.

BY

Albert L. Arner

The use of the ballistic galvanometer, I think, is quite generally regarded as tedious, judging from the references made to it in the journals and manuals for students. This arises from the trouble experienced in bringing the needle to rest after a "throw" has been made. Numerous suggestions have been made as to the best means of minimizing this labor. Some experimenters use a magnet in one way or another; others, an auxiliary coil, battery and key. The present writer uses a method much simpler than any of these, inasmuch as no auxiliary apparatus of any kind is needed.

Suppose we are comparing E. M. F.'s by the condenser method, with the apparatus set up as shown below. Let the lever of the Kempe key be in the insulated position; if now, the operator place one finger of his hand upon post A of the key and another finger upon post B, a circuit through the battery, galvanometer and hand will be formed. This current with a sensitive galvanometer, is sufficiently strong, is completely under control, and to stop the needle possesses even an element of pleasure.



Controlling the Ballistic Galvanometer.

THE BELL TELEPHONE COMPANY'S INSTRUMENT STATEMENT.

The Bell Telephone Company makes this instrument statement for the second month of the fiscal year and two months:

Shipments to Feb 20, 7,750; returned, 5,123; net output, 2,627. Net output since Dec. 20, 4,852; instruments in use Feb. 20, 556,591, showing an increase of 41,223 since the same date last year.

INFLUENCE OF FREQUENCY ON THE WORKING OF ALTERNATE CURRENT TRANSFORMERS.—III.

BY

Chas. Steinmetz.

In Fig. 3 are given the characteristic curves of the transformer, for the three different frequencies 36.3, 137.5 and 204.5, and a primary voltage of 840 volts effective.[1] As abscissæ are used the currents taken from the secondaries of the transformer, that is, its output.

The first three curves are the primary currents required at the different frequencies. As seen, the *leakage* current, or primary current on open secondary circuit, is at the frequencies 204.5, 137.5 and 36.3, respectively, .038, .048 and .15 ampere effective, and increasing the frequency reduces the leakage current. The full-load currents are: .515, .525 and .565 ampere effective, at 10 amperes secondary current.

The secondary E. M. F. is practically the same for all the three frequencies, starts with 41.8 volts at open circuit, and drops down to 39.8 volts at full load, and to 37.3 volts at double load.

The whole losses in the transformer are given in watts by the three curved lines in the upper half of the diagram, and amount to 14, 19 and 42 watts respectively on open circuit, and to 38, 43 and 66 watts at 10 amperes secondary.

Allowing 50 watts as the maximum loss permissible by the heating of the transformer, it will have a capacity, or an output of:

12.3 amperes at 204.5 periods.
11.3 " " 137.5 "
5.7 " " 36.3 "

The three efficiency curves are given at the top of the diagram. They show, that for higher load the efficiencies do not differ very greatly for the three frequencies, being 85, 90 and 91 per cent., respectively, at 10 amperes output. But for light load the efficiencies differ greatly, and are higher, the higher the frequency.

Thus, for one ampere secondary current the efficiencies are respectively: 48, 68 and 75 per cent. For $\frac{1}{10}$ load, that is, .57, 1.13 and 1.23; amperes respectively, the efficiencies are: 38, 71 and 78 per cent. respectively. Since the all-day efficiency largely depends upon the efficiency at lighter loads, at high frequencies this transformer will be far superior in all-day efficiency than with low frequency. It must be understood, however, that the values of efficiency found in this transformer, can have a *relative* meaning only, since this transformer is an old transformer of small capacity, and consequently not to be compared with the modern transformers of larger out-put, or even of the same out-put, which, as is well known, reach far higher efficiencies.

The question now arises, how does the *output*, and the *efficiency* of the alternate-current transformer depend upon the *frequency?* The output of a given transformer is limited by the heat developed, that is, the energy lost in the transformer. This loss of energy, L, consists of the loss in the copper, L_1, by resistance, and the loss in the iron, by hysteresis, etc., L_2. Let the maximum permissible loss of energy in the transformer be: $L = 2\,A$. Then we have: $L_1 + L_2 = 2\,A$.

Now the efficiency is highest, and consequently the output of the transformer, with a given internal loss $2\,A$, largest, when the loss in the iron is equal to the loss in the copper, or when: $L_1 = L_2 = A$.

Hence, for establishing the influence of frequency, we have to work the transformer at all frequencies at its maximum point of efficiency and output.

The loss in the copper is: $L_1 = a\,c^2$ where c is the secondary current, a a coefficient, either calculated from the constants of the transformer, or determined by tests. The loss in the iron is:

$$L_2 = b\,N\,B^{1.6},$$

when $N =$ frequency, $B =$ intensity of magnetization, and b a constant, calculated in the well-known manner, or observed.

The E. M. F. is: $E = f\,N\,B$; and the output $W = Ec$.

The transformer under consideration is built for
$N = 137.5$ periods, $E = 50$ volts, and $c = 10$ amperes, and under these conditions gives:

$L_1 = 25$ watts. $L_2 = 25$ watts. $B = 4.6$ kilolines.

Consequently, we get the constants: $a = .25$, $b = .015,8$ $f = .079$; and for the out-put the value:

$$W = 79\,N^{\frac{3}{8}};$$

and the efficiency $\gamma = 1 - \dfrac{.633}{N^{\frac{3}{8}}}$

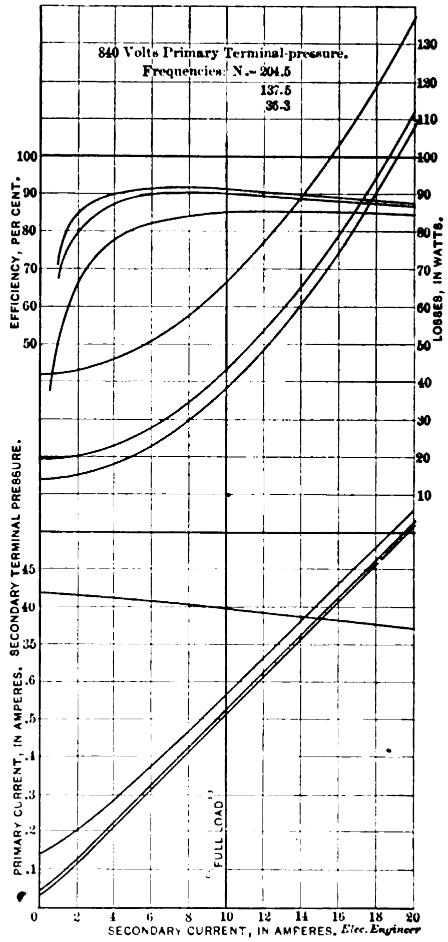


FIG. 3.—CURVES SHOWING EFFICIENCY, OUTPUT, ETC., AT DIFFERENT FREQUENCIES.

This means that:

The output of an alternate current transformer is proportional to the $\frac{3}{8}$th power of the frequency.

Hence it will vary only slowly with varying frequency.

This proportionality of the output with the $\frac{3}{8}$th power of the frequency holds, however, only within a certain range. that is, beyond a certain minimum value of the frequency, For, from the constancy of the iron loss it follows, that for decreasing frequency N, the induction B has to be increased.

Now the induction B cannot be increased infinitely, but reaches a value of saturation, and already below this value, the distortion of the current wave—and especially the large increase of the lagging leakage current, with its disagreeable reaction on the excitation and plant-efficiency of the alternator,—limits the magnetization. As soon as this limit, say $B = 10$ kilolines, is reached, the magnetization has not to be increased farther, and consequently, with decreasing frequency the iron loss decreases below half the permissible loss. The copper loss can be increased correspondingly, but the transformer cannot work any more under full load at its point of maximum efficiency, and output and efficiency rapidly drop off.

---

[1] 840 volts have been chosen instead of 1,050, where the transformer is built for, because at 1,050 volts with a frequency of 36.3 the "*leakage current* would be beyond the carrying capacity of the primary wires."

In the transformer under consideration, the maximum permissible magnetization $B = 10$ kilolines is reached at about $N = 40$ periods, and below that the output it given by: $W = .79\ N\ \sqrt{200 - 2.52\ N}$ and the efficiency by:

$$\gamma = 1 - \frac{63.3}{N\ \sqrt{200 - 2.52\ N}}.$$

The curves of output and of efficiency as functions of the

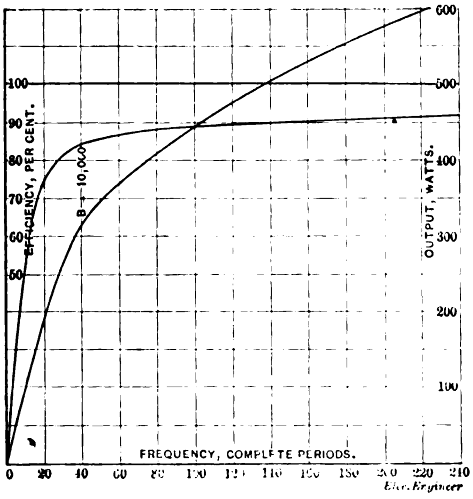


Fig. 4.

frequency, as abscissæ, are given in Fig. 4. As seen, the efficiency varies rather little at medium and high frequency, but turns abruptly down between 20 and 40 periods. The output at 80 periods is 410 watts, at three times the frequency, or 240 periods, 615 watts, or only 50 per cent. larger, while the efficiency has increased only by 4 per cent., and would have changed still less in a transformer of higher efficiency.

To reach a high efficiency under light load, and consequently a good all-day efficiency, it is however, especially in larger transformers, advisable to work the transformer far beyond the point of maximum efficiency, that is, to make the full load copper loss L_1 larger than the iron loss L_2; for instance $L_1 = 2.5\ L_2$ in the Stanley 17.5 K. W. transformer. By this means, the point of maximum efficiency is at lighter load, and the light-load efficiency is greatly increased.

It needs hardly to be remarked, however, that, keeping the ratio of full load copper loss and iron loss constant, for instance at $L_1 = 2.5\ L_2$, we arrive at exactly the same conclusions with regard to the influence of the frequency on efficiency and output.

Eickemeyer Laboratory, Yonkers, N. Y.

CLASSIFICATION OF WORLD'S FAIR EXHIBITS.

As some exhibitors have found difficulty in properly classifying their exhibits, a new group, 138 A, has been added to the Department of Electricty, subdivided as follows:

Group 138 A, *a*, construction tools, repairing tools, apparatus used in electrical construction; *b*, apparatus for transmission of power to electrical generators, (steam, compressed air, turbine, oil, friction, gearing, belting, etc., etc.); *c*, processes of electro-engraving; *d*, carbon and its application; *g*, metals and their application in the construction of electrical apparatus; *h*, the "kinetograph"; *j*, direct coupled engine-dynamos; *k*, electric lubricators; *l*, application of electricity in testing and ageing liquors; *m*, electric tanning.

A CURIOUS ACTION OF ATTRACTION BY ALTERNATING CURRENTS.

BY

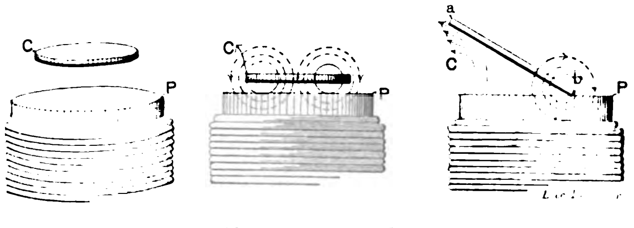
Elihu Thomson

A curious case of apparent attraction of closed circuits in the neighborhood of an alternating magnetic pole which was found in experimenting on the repulsive effects is worth recording.

Let P, Fig. 1, be an alternating magnetic pole, produced by a bundle of iron wires surrounded by a coil through which alternating currents are passed, and C a copper disc considerably smaller than the pole end P. As the disc C is approached to P it will of course be found that it is repelled or that a certain force has to be overcome in bringing it nearer and nearer. It will be found, however, that instead of increasing, as it nears the pole after a certain position has been passed, the repulsion diminishes, then disappears, and is at last replaced by an attractive force of considerable amount which increases down to the position of actual contact with the pole. It is assumed that the disc C be kept parallel to and central with the pole face P

The explanation of this apparent anomaly is, I think, simple. The attraction appears to be due to the nearness of the disc C to the iron core. Currents are induced in C which, owing to the small diameter, relatively, do not suffer as great lag as when induced in rings or discs which encircle the pole. These currents exert an attraction for the iron of the core which at last becomes superior to the effort of the repulsion, which is feeble. The induced currents in C, in seeking a better magnetic circuit for their induction, cause the disc C to approach the core. The strongest attraction will of course exist when the current which energizes the pole P is passing its zero value. At this time the attraction will be understood by a glance at Fig. 2, where the magnetic effects of currents in C now have free action on the pole P.

A pretty modification of the experiment and one in which both attraction and repulsion take part is indicated in Fig. 3. The disc may be set in the inclined position, as shown, and attraction at *b* may keep it from being thrown off the pole, while repulsion at *a* sustains something less than one-half the weight of the disc in the inclined position shown. If the alternating pole be presented in a horizontal direction, it will also be found that the disc will adhere to the pole and slip down to a position below the centre. If it slips too far down, the attraction is at once replaced by a quick repulsion which casts the disc away from the pole quite suddenly. With the pole completely inverted or facing outward, the attraction will be sufficient, in some cases, to hold the full weight of the disc against the pole.



Figs. 1, 2 and 3.

TELEPHONE RATES IN MISSOURI.

The House of Representatives of Missouri has passed a bill establishing maximum telephone rates at $50 per year in cities of over 100,000 inhabitants, $40 between 30,000 and 100,000 inhabitants, and $30 in all other cities of the State.

RECENT IMPROVEMENTS IN THE HEISLER LONG DISTANCE SERIES SYSTEM OF ELECTRIC LIGHTING.

BY

William Smith Horry

THE HEISLER long distance series system of electric lighting was first introduced in St. Louis several years ago. An alternator was constructed there capable of operating in series 250 incandescent lamps of high candle-power. The current of this machine was kept constant by both electrical and mechanical means; and a standard lamp of 32 candle power requiring 5 amperes was adopted. Since that time this system has had a very extended application, and it is to this day one of the most practical systems for economical street lighting by incandescent lamps. It was devised before the time when alternating apparatus was appreciated in this country. It was produced at a time when series incandescent lighting was quite new and before the days of the commercial transformer.

Considerable difficulty was at first experienced with the cut-out employed to short circuit a burnt out lamp. The magnetic cut-outs were uncertain in their action, and would act prematurely if jolted. They were therefore abandoned, and in their place a cut-out acting on another principle was employed, depending for its action on the fact that a considerable difference of potential is developed at the terminals of such a lamp. This potential difference is now made use of to fuse a carbon compound which carbonizes and becomes conducting. Since the introduction of these cut-outs which are comprised in the lamp holder we have had no trouble and to all intents and purposes the Heisler lamp holders are as convement as any socket working on the constant potential system.

The lamp employed by the Heisler Company which requires 5 amperes and 14 volts is quite a substantial one when compared to the filament lamps in other systems; it is also more stable in candle power than any other I am aware of. The current being constant, the efficiency rises with age, rather than falls; this is a point of considerable importance and one that does not apply in any other system. As the carbon wears away the current heats it up more and more, so that it gives more and more light until it finally breaks. This action is of course counteracted to some extent when the lamp blackens, but the fact remains that a rise in efficiency is infinitely preferable to a fall in efficiency when an electric lamp has been much used.

The company has recently been putting out its improved method with which it challenges comparison for economy and safety. For house illumination we use an induction coil. This device which we think much more efficient than the ordinary transformer is supplied from the street mains with five amperes. The secondary winding is substantially the same and provides a five ampere current. For this reason it is not a transformer at all, nor does it conform to the well understood losses common to all transformers. It transforms neither up nor down; it generates a new current precisely similar to the first and it keeps the high potential out of the house.

For these reasons we call our apparatus "Reduction Boxes." These reduction boxes then are used similarly to transformers except that the primary wires are all in series with the main line. The secondary wires enter the house and illuminate the lamps in series. The voltage in the wires rises with every lamp turned on; the current remaining substantially the same. At no load the secondary wire is practically short-circuited and in this condition the contrivance has almost 100 per cent. efficiency; at no load there is no lag and no loss substantially, the very small loss that does occur being nearly all due to ohmic resistance. There is no magnetism in the iron as that is demagnetized by the secondary current. The ohmic resistance in the copper which is constant for all loads can be reduced to almost nil by proper proportioning. In our ten-light transformer the losses from all causes are not more than seven watts at no load. As lights are turned on there is a slight falling off of current, so that at full load the efficiency is 97½ per cent., the same as in the best transformers. With ten 32 candle power lamps the primary and secondary voltage is 145 volts.

In other words our reduction boxes are nothing more than induction coils utilized at those very points of induction which have to be discarded in step down transformers. These transformers are quite wasteful at no load, have an efficiency of say 20 per cent. with one lamp burning and the efficiency rises from that to 97½ per cent. at full load. There they stop and there we begin and with us the efficiency rises beyond that figure, as the lamps are turned off, until it becomes the highest possible when no lamps are burning.

The meter we have so far used with this apparatus has been that of Professor Thomson, which is quite accurate. All we really need, however, is a recording voltmeter which registers in lamp hours.

Another advantage of this system is that these high efficiencies apply with greater force to small than to large induction coils. We only make five to ten light reduction boxes at present. Each of our lamps is of 32-candle power; should we make them larger the potential would increase beyond the safe limit. We also provide a cut-out on the secondary main so that the consumer can, if he chooses, cut out his meter and his line. This is precisely similar to shutting off your gas every night at the meter, and is very satisfactory.

ENGINEERING AND PHYSICS AT McGILL UNIVERSITY, MONTREAL.

THE recently completed Engineering and Physics Buildings of McGill University at Montreal were formally opened on February 24 by Lord Stanley the Governor-General of Canada, in the presence of a large gathering of distinguished guests, including representatives of other universities in Canada and the United States. These buildings and the equipments of their laboratories as well, are the munificent gifts of Mr. W. C. McDonald of Montreal.

The opening of the Engineering Building took place in the morning and that of the Physics Building in the afternoon. The exercises comprised the presentation of the keys of the building by the donor to Lord Stanley who then declared the buildings open, in appropriate addresses. Speeches were made by many of the visitors from various parts of Canada and the United States, who joined in congratulating the University and the country at large upon the acquisition of the two buildings and their laboratories, which were pronounced to be the finest and best equipped engineering and physical laboratories on this continent. Mr. McDonald was highly praised for his magnificent donations in the interest of science.

The buildings are large cut-stone edifices of five stories each and contain a number of handsomely finished laboratories and lecture rooms. No expense has been spared in equipping the laboratories with a complete collection of the latest and best apparatus that could be obtained, Mr. McDonald's instructions being to get the best, regardless of the cost. The Engineering Building is devoted to instruction in the different branches of engineering, while in the Physics Building the principles of physical science are taught, which besides being essential in the study of applied science are now a necessary part of a liberal education. An important work to be carried on here is that of scientific research, for which the most delicate and exact instruments are provided. Unexcelled facilities are thus afforded for acquiring a thorough education in electrical engineering and the other branches of applied science.

MR. A. A. KNUDSON BEFORE THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

AT the Brooklyn Institute of Arts and Sciences on Friday evening, March 3, before an audience which filled the room, Mr. A. A. Knudson lectured on Magnetism in its relation to Animal Life. The lecturer first spoke of the discovery of magnetism, its application in the needle of the compass, spoke of the lodestone, and, fortunately, was able to illustrate this by such a stone.

Mr. Knudson's main point was that magnetism had no appreciable effect upon animal life, and to show this he placed upon the poles of an immense electromagnet, which had been constructed by removing the armature from a 10 h. p. motor, a canary bird, then a jar of gold fish, then a cat, and finally a rabbit; with the two latter he placed them directly in the path of the magnetic field. Two or three gentlemen fondled the electromagnet lovingly, placing their hands upon it, and laying their heads on it, declaring no effect was noticed when the circuit was closed or opened. It was shown that the interposition of the human body in the field had no effect upon the magnetism, Mr. Knudson readily deflected a needle placed at one side of his head by means of a telephone receiver placed at his ear on the opposite side of his head to the needle, while others, placing their heads against the electromagnet, had screws attracted to their foreheads. Discussion followed.

MR. FRANK R. STOCKTON AS AN ELECTRICAL LITTERATEUR.

THE publishers of *The Electric Spark*, 1,111 Monadnock Building, Chicago, have made a distinct departure in electrical journalism by making that journal very much on the pattern of the magazines and comic papers. It is about to begin the publication of an original story by Frank R. Stockton, illustrated by A. B Frost, entitled: "The Watchmaker's Wife." This is a clever bid for popularity and circulation, and deserves to succeed.

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Asso. Editor: George B. Muldaur.

New England Editor and Manager, A. C. Shaw, Room 70—620 Atlantic Avenue Boston, Mass.
Western Editor and Manager, L. W. Collins, 575 The Rookery, Chicago, Ill.
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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* The Electrical Engineer. *Communications for the attention of the editors should be addressed,* Editor of The Electrical Engineer, 203 *Broadway, New York City.*

Vol. XV. NEW YORK, MARCH 15, 1893. No. 254.

TELEPHONES NOW.

THE Bell patent of 1876 is no more. Its life ended March 7. The Bell Company are expecting an avalanche of competing telephones in the near future and have been busy for the past week or so getting up blank injunction papers to be fired at the first daring wight who sticks his head up in contravention of the second patent of Jan. 30, 1877. There is every reason to expect that the opportunity for a first shot will soon appear. It will be interesting to watch the discharge, and see whether the missile bring down the game, or whether a chase of some duration ensue.

It is to be hoped that the sport is not to be all on one side. Let Attorney-General Olney answer fully those who criticise his appointment on the ground that he is intimately connected in business relations with large owners in the Bell Company, by prosecuting with all possible dispatch the suit to annul the Berliner patent, instituted by his predecessor in the Department of Justice. The course of the Government suit against the Bell patent—whether that case was meritorious or otherwise—ought not to be repeated. It is seven years since that case was begun and testimony is still to be taken. The suit has outlived the patent. A judgment, should it ever come, can now have but an academic interest.

TRANSFORMER FREQUENCY.

In the brief series of articles which is concluded in this issue Mr. Chas. P. Steinmetz takes up a question of the utmost importance in the operation of alternate current transformers. A short while ago Prof. W. E. Ayrton and Dr. W. E. Sumpner read a paper before the British association, on the Efficiency of Transformers at Different Frequencies, in which they showed that with closed circuit transformers the core losses are practically constant at all loads. They also showed that the greater the frequency the higher the efficiency at any particular load, and that the greater the load the higher the efficiency at the same frequency. Mr. Steinmetz has devoted his attention principally to the study of the influence of frequency on the working of transformers, and one of the important results reached by him is the fact that the iron loss per cycle is the same for slow as for high frequency, which means in effect that the hysteretic losses per cycle are independent of the frequency. It follows from this that if eddy and Foucault-currents be excluded, the magnetization and hysteretic losses in transformers up to 200 complete periods per second can be predetermined by means of tests with slow cycles—magnetic viscosity and viscous hysteresis being absent. The tests of Prof. Ayrton and Dr. Sumpner included frequencies that range between 107 and 200 periods per second, while those of Mr. Steinmetz extend over a range of from 36.3 to 204.5 complete periods per second, up to which period he has shown that magnetic viscosity is still a vanishing quantity. In this week's issue Mr. Steinmetz brings out a most interesting relation between the output of an alternate current transformer and the frequency. He shows, in effect, that within certain limits the output is proportional to the $\frac{5}{8}$-power of the frequency, and thus establishes for the first time a relationship between two highly-important elements in transformer design.

MOTOR AND TOOL IN ONE.

The efforts of engineers have always been exerted to apply power to machines in the most direct manner possible for the purpose of avoiding intermediate gearing of every description, with its resulting consumption of power; and hence the electric motor was hailed by many as a means for carrying out their long-cherished plans. Strange as it may seem, however, little, if anything, has been done looking towards the direct driving of machine tools and the multitude of other apparatus to which electric drivers could be easily applied. It is therefore with more than ordinary satisfaction that we note the first comprehensive effort made to carry out in a practical manner this much delayed work. The motor designed by Mr. Imle E. Storey for this purpose, which we describe on another page, shows every evidence of much thought to evolve a machine adopted to every-day practical requirements; and now that an earnest start has been made in this limitless field we believe we are justified in the assumption that the days of shafting and belting are numbered for the ordinary purposes of machine driving, wherever the electric current is obtainable.

General Electric.

The persistence with which the rumors of a change of management are repeated, may have some connection with the decline of General Electric stock last week to 98. The annual meeting on April 11 will prove unusually interesting. The assumption of these rumors is that Mr. Coffin has found his burden too heavy, and seeks to relinquish it. He will be a brave man who takes up a task to which Mr. Coffin's ability was unequal.

ELECTRIC RAILWAY DEPARTMENT.

THE ROCK CREEK RAILWAY, WASHINGTON, D. C.

BY

Paul A. Draper.

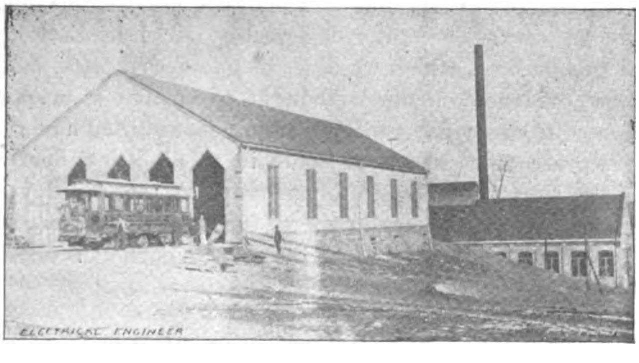
THE SITUATION.

THE history and development of the modern electric street railway for rapid transit both in cities and the suburbs is ever of interest to the electrical as well as the mechanical engineer

Of all cities in the United States, Washington, D. C., is the one that most appreciates an electric railway. Congress for the past few years has been giving the matter of rapid transit in the District of Columbia grave consideration. It has prohibited the erection of overhead wires within the city limits, but permits them to be erected outside of the boundary line. This restriction prevents the construction of overhead trolley electric roads within the city proper, and has driven syndicates inclined to use this system to adopt the underground system in the city. They, however, take advantage of the limits, and use the overhead trolley system outside of Florida avenue, the city boundary.

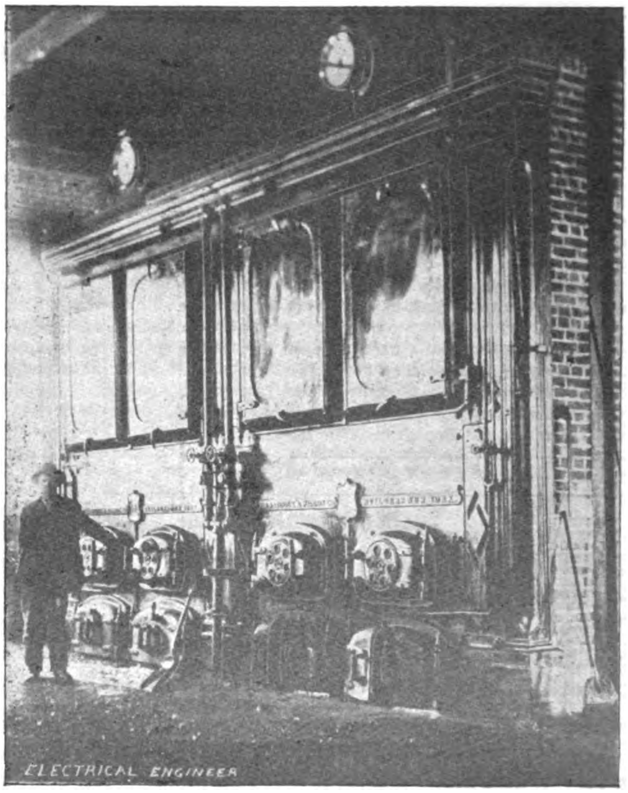
The latest overhead trolley road constructed and now in operation is that known as the Rock Creek Electric Railway. The total length of the road is six miles, double-tracked its entire length, with five cross-over switches placed at suitable points. The road-bed is very substantially built, ballasted with hard earth and broken stone, and a 55 pound girder rail is used, thereby insuring a speed of over 30 miles an hour with safety.

Starting at the intersection of Eighteenth and U streets and Florida avenue the road runs north to Columbia road, thence west to Connecticut avenue (extended), passing the National Zoölogical Park, then north again to Chevy Chase. This is a beautiful suburb of Washington located on a high plateau overlooking the city, about seven miles north of the President's House, in Montgomery County, Maryland. The property was purchased by the Chevy Chase Land Company a few years ago. and has been sub-divided into building lots. It has been laid out very artistically into beautiful streets and avenues, and has a complete sewage and water-works system, which was completed before the erection of any house. Electric lights are to be used entirely for the lighting of residences and streets. The several hundred adjoining acres owned by the company is being rapidly improved, and within a short time Chevy Chase will be one of the largest and one of the handsomest suburbs of the Capital City.



CAR AND POWER HOUSE, ROCK CREEK RAILWAY, WASHINGTON, D. C.

The route of the road is through a very beautiful portion of Washington's surrounding country, and the landscape scenery viewed from the cars bids fair to equal that of the old historic canal pike-road of the upper Potomac, which is noted for its beautiful, rugged scenery. The road crosses two handsome bridges which were constructed for the railway company, and are known as the Rock Creek Bridge and the Klingle Bridge. The former was built by the Edgemoor Bridge Company of Edgemoor, Delaware. It is an iron structure of the link form and so built as to give it an semi-arch appearance when viewed from the valley. It is 135 feet high, 750 feet long and 54 feet wide. The Klingle Bridge was built by the Youngstown Bridge Company, of Youngstown, Ohio, and is of the pin bridge type. This is a very pretty bridge and is substantially constructed.



BOILER PLANT, ROCK CREEK RAILWAY, WASHINGTON, D. C.

The residents of Washington are given very much to summer rides on suburban electric railroads. There are six of these roads now in operation in the District of Columbia and one or two more under construction.

In order that the Chevy Chase Land Company might enhance the value of their property and still further improve it and bring it to the notice of the public by direct communication, they entered into a contract with the General Electric Company to build them an electric road of the very best material and of the most modern style.

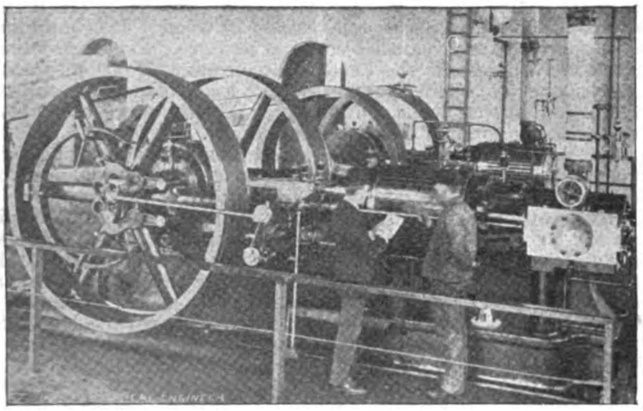
THE BUILDINGS

are situated at the further end of the route. A general view of them is shown on this page. They are very substantially built. The car house if a frame structure 130 feet long by 56 feet wide and 36 feet high, with a king-rod truss roof. It has five tracks running its entire length which are laid in such a manner as to facilitate easy handling of the cars. In the rear of the car house is a pit which is for the purpose of examining motors and other machinery under the cars. It measures 76 feet long by 20 feet wide by six feet deep, and has two tracks over its entire length. There has been constructed in this pit a novel little elevator, whose platform measures four feet by two and a half feet. It is worked from underneath by a hydraulic jack, and is used for lowering the lower field castings of the Thomson-Houston waterproof motors.

The cars are 18 in number. Six 32-foot cars with Robinson radial trucks, six 16-foot cars with Peckham cantilever non-oscillating flexible wheel trucks, and six open cars. The last are used as tow cars or trailers. The Robinson radial trucks are equipped with two Thomson-Houston waterproof motors, type 50, 25 horse power each. The Peckham trucks are equipped with two Thomson-Houston waterproof motors, type 30, 15 horse power each. The wiring of the cars is done in the latest improved Thomson-Houston style, using their new and improved series-parallel controller, which has given excellent results.

THE POWER HOUSE,

which is built in a most substantial manner, measures 110 feet 10½ inches long by 57 feet 9 inches wide by 35 feet high, with a king-rod truss roof. The entire structure is built of brick and rests upon a natural bed of rock. The foundation walls, which are also of brick, are 32 inches thick at the bottom and 14 inches thick at the top, and carry a wall which is 13 inches thick throughout. These walls are reënforced by 24 pilasters, 12 on a side, measuring 18 by 18 inches, which support the trusses of the roof. The roof is of corrugated iron and, of course, like all iron roofs, sweats to a greater or less extent where steam engines and piping are used. The sweating is prevented very effectually by a compound known as "Mackite," which is composed of plaster of Paris and reeds. This material is put up in panels four feet long by 18 inches wide by one inch and a half thick, and is placed about three inches below the roof. The coal is delivered to the place by the Southern Metropolitan branch of the B. & O. R. R., which runs within a few feet of the boiler room end of the power house.



ENGINES, ROCK CREEK RAILWAY, WASHINGTON, D. C.

THE BOILER ROOM.

The boiler room measures 47 feet 9 inches long by 57 feet 9 inches wide and is separated from the dynamo room by a wall 18 inches thick, which is built to the roof. This portion of the building has a large ventilator on the roof. At present there are installed two Babcock and Wilcox water tube safety boilers of the regular standard pattern, shown on page 264. Each boiler is 184 nominal horse power capacity, having a heating surface of 2,112 square feet with grate area of 44 square feet. There is room for two more boilers of the same size or larger, in case it should be necessary to increase the output of the plant. This available space is now occupied by a first class equipped blacksmith and repairing shop, with all necessary tools in connection with a modern electric railway plant.

The boilers have a plain setting and are intended to work at a pressure of 120 pounds per square inch. In the boiler room there are two Worthington duplex pumps for supplying the boilers, and a Wainwright improved corrugated tube-feed water-heater.

In the rear of the boilers there is built a brick smoke flue 5 feet 3 inches high by 4 feet 2 inches wide, lined with fire brick. This flue is run into a brick foundation, 12 feet by 12 feet by 15 feet high, upon which rests the sheet iron chimney. This chimney is 105 feet high by 54 inches in diameter. It is calculated for 500 h. p., and is held in position by eight steel wire guy cables anchored to as many Georgia pine dead men 10 inches square, 16 feet long and set eight feet in the earth.

From each boiler runs a six inch wrought iron steam pipe into a 10 inch-header. From this runs another steam pipe 10 inches in diameter to a 10 inch separater, for separating any water that might be in the steam at the time of its delivery to the cylinders of the engines, so that they will receive perfectly dry steam.

The valves used throughout the steam piping are the well-known Chapman gate valve. All the pipes are covered with magnesia sectional covering.

THE ENGINES.

There are two high speed engines shown on this page, a McIntosh & Seymour tandem compound condensing, size 13 x 23 x 17 inches, and a Ball & Wood cross compound condensing, size 15 x 26 x 16 inches. The McIntosh & Seymour engine is 250 h. p., has two fly-wheels each measuring 90 inches in diameter and governed to run at a speed of 195 revolutions per minute. The high pressure cylinder is live steam-jacketed, covered with asbestos and lagged. This engine is fitted with automatic relief valves as a protection to the cylinders. In case an undue amount of water should pass the separater from any cause and get into the cylinders of the engine the automatic relief valves, which are set at a given pressure and are of sufficient area, will open to allow the water to pass out, thereby greatly decreasing the danger of blowing out the cylinder heads.

The Ball & Wood engine, which is of their latest type, and is shown in the background of the cut above referred to, is of 250 h. p., making 208 revolutions per minute. It has two fly wheels 48 inches in diameter.

Both of these engines can be run either condensing or non-condensing.

The exhaust pipes of these engines are fitted with automatic atmospheric valves. These valves are for use in case the vacuum is lost, or any trouble should arise in connection with the condensing apparatus, which would allow the engines to exhaust into the atmosphere.

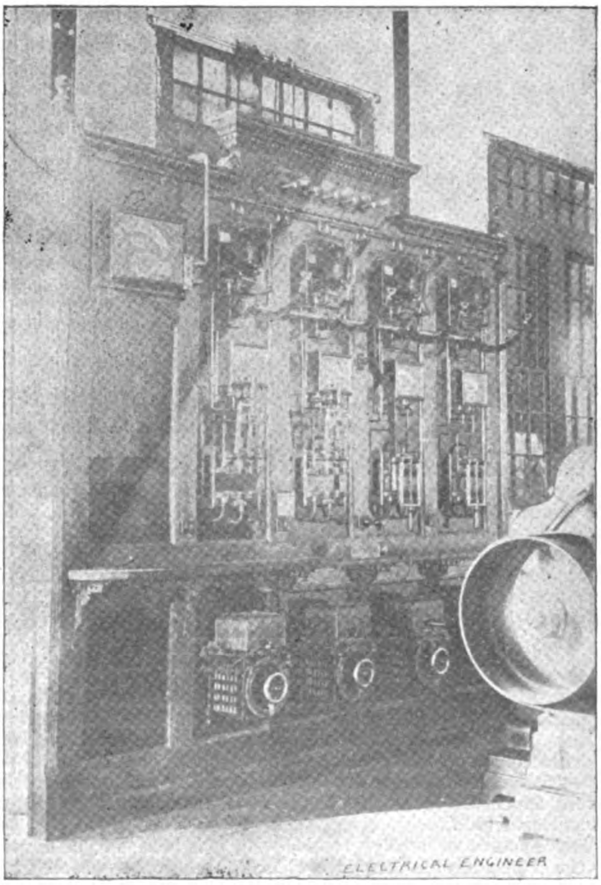
Exhaust pipes and atmospheric valves are run underneath the floor into a brick pit with a concrete floor. The pit has trap doors, in order that free access may be obtained for examining pipes, etc.

The two engines are fitted with Detroit lubricators, sight feed oil cups and Lunkenheimer sight feed oil pumps.

THE PUMP PIT.

This is located in one corner of the engine-room, the descent into it being made by a short flight of iron steps. The pit measures 7 feet wide by 15 feet long and is 12 feet deep. It contains an improved Blake independent jet condenser pump, also a Blake automatic pump and receiver, for returning all water that drips from the steam pipes to the boilers.

Across a small stream, passing the power house, which is a branch of Rock Creek, is a dam, built of rubble stone, measuring 25 feet long, five feet high and 18 inches thick. From this stream runs a 12-inch terra cotta pipe line, with a drop of 12 inches, into a circular well in the rear of the power-house supplying 2,000 gallons of water per minute for condensing purposes.



SWITCH BOARD, ROCK CREEK, RAILWAY, WASHINGTON, D. C.

THE GENERATORS.

There are four 90 kilowatt Thomson-Houston multipolar generators, each making 700 revolutions per minute, compound wound and adjusted for no per cent. drop. They are belted direct to the engines by four Schieren perforated electric belts, each 18 inches wide, the distance from centre to centre being respectively 16 feet 8 inches and 24 feet for both units. Each generator is fitted with self-oiling and self-aligning bearings. The generators are placed on brick foundations six feet deep.

THE SWITCH BOARD.

The switch board shown on page 265 is ten feet high by eleven feet long, made of quartered oak with marbleized slate panels, divided into five sections, one for each of the four generators and the fifth for the main current indicator. Each panel has a Thomson-Houston automatic circuit breaker, a 180 ampere indicator, a triple pole single throw 200 ampere station switch and a fireproof rheostat. At the top of the switch board are seen five 100 volt pilot lamps. These lamps give a very pretty effect when lighted. This switch board is considered one of the prettiest and one of the best arranged in the District of Columbia.

A novel little arrangement, recently gotten out by the Thomson-Houston Company, is a magnetized needle suspended vertically on the front side of the positive wire on the switchboard. This is for the purpose of showing the direction of the flow of the current and enables the electrician in charge to discover any reversal of the current. Should a generator reverse the flow of its current this little needle will deflect to the left and when flowing in the proper direction it is deflected to the right. When no current is flowing it stands vertically, and is held in this position by a small brass weight attached to its lower end.

THE LINE.

The overhead construction is substantially built. Beginning at the city terminus, iron poles, manufactured by the Walworth Manufacturing Company of Boston, are used for about 3,000 feet. Leaving off here cedar poles are used. These have ornamented iron brackets as well as the iron poles, and are painted with black water-proof paint. All the poles are set in broken stone and cement and are placed 125 feet apart in the centre of the tracks, centre pole bracket suspension being used the entire length of the road.

The trolley wire is number 00 throughout and is of hard drawn copper, made by Washburn & Moen Manufacturing Company, of Worcester, Mass., and is guaranteed of 98 per cent. conductivity.

The insulated feed wires, are three 00 and one stranded cable, whose cross section is equivalent to three 000 wires. These feeders are run as follows: The three 00 wires are run to points on the route 7,000, 14,000 and 21,000 feet respectively from the power station. The fourth wire or cable is run to a point measuring 29,000 feet from the power station, or very nearly the entire length of the line. It will be seen that there is very little drop in the voltage, if any, at the further end of the line, where so ample an amount of copper is used for feed purposes.

The joints of the rails are double bonded and connected with a No. 1 supplementary copper wire. Large ground plates are sunk in streams and creeks crossing the route.

The trolley insulators, clips, strain insulators, and pole insulators are of the Thomson-Houston type.

The whole work has been done in a first-class manner, and the company is greatly pleased, and it is due to the fact that the constructors have spared no pains or expense.

The general plans were placed in the hands of Mr. W. Kesley Schoepf, the civil engineer, and Mr. Leon E. Dessez, the architect. The details were carried out by General A. J. Warner, who had the entire supervision of the construction of the road.

The officers of the company are: Francis G. Newlands, president; Edward J. Stellwagen, vice-president; Howard S. Nyman, secretary; Thos. M. Gale, treasurer; Gen. A. J. Warner, general manager.

TROLLEY EXTENSION IN RHODE ISLAND.

THE plan to generally extend the electric street railroads, in opposition to the steam roads for local transportation has received an impetus in the Rhode Island House of Representatives, by the presentation of an act in admendment of the charter of the Woonsocket Street Railroad Company, authorizing that corporation to extend its lines through the towns of Lincoln, Cumberland and North Smithfield.

The system of trolley roads, will, it is believed, be controlled by the Philadelphia and New York syndicate which has just bought up the Union Horse Railroad Company's property and stock in Providence.

The plan of the syndicate is to take in all the street car companies in the state from Newport to Woonsocket, and connect them with the Interstate, which road extends well into Massachusetts, and by which it is contemplated to make direct communication with Worcester and Boston.

A 24-FOOT GAUGE ELECTRIC RAILWAY.

LONDON *Invention* says that it is proposed to build on the beach between Brighton and Rottingdean, England, an electric railway nearly four miles long with a gauge of 24 feet.

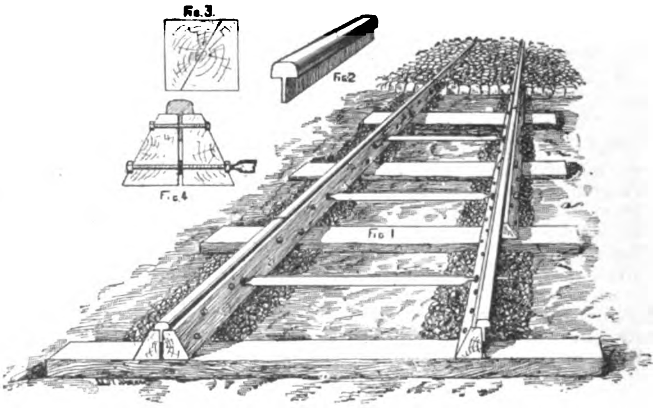
THE STILLMAN RAIL.

AT the last convention of the American Street Railway Association at Cleveland, Ohio, nearly an entire evening was spent in discussing rails and their joints. Mr. Paine of Milwaukee, Wis., and Mr. Little of Buffalo, N. Y., recommended heavy rails weighing from 80 to 100 lbs. per yd., with extra strong joints, and laid on cross ties. Mr. Pearson of Boston, Mass., and Mr. Beckley of Rochester, N. Y., showed conclusively that a better construction could be obtained from a much lighter rail supported entirely on stringers.

Dr. H. L. Stillman of Kenyon, R, I., has recently perfected a compound continuous stringer-rail which saves fully one-half in steel and iron and above one-quarter in wood. It is composed essentially of three parallel running sections: a steel girder section which represents the head of an ordinary T rail minus the under bevel or bracing portion, with a knife blade web, and two lateral supporting wood sections that take the place of both the base of the common T rail and the stringer.

The compound rails are made of sections thirty feet long, with cross ties ten feet apart, with middle space gauge rods, breaking joints, with two whole continuous sections over each tie.

By the diagonal splitting of the stringers the rail base is increased in width and holds the steel in the most complete allignment. The separating washer effects a complete drainage under the steel section. To produce the beveled stringers an ordinary timber is divided diagonally with a saw, as shown in Fig. 3, the left hand section being inverted, reversed end for end and brought into the position of the right-hand one in Fig. 4.



FIGS. 1, 2, 3 AND 4.—THE STILLMAN COMPOUND STRINGER RAIL.

The vertical or web portion of the rail is placed between the two lateral sections of the stringer with the horizontal portion resting upon them, the lower portion of the sections being separated by a washer and the whole firmly secured by bolts.

A broad and firm bearing is thus given to the stringers and the top narrowed to accommodate a comparatively light rail section.

In the common T rail of an average weight of 63 lbs. per yard, 55 lbs. is said to be thrown out as scrap, when the rail is worn out, while this rail section, weighing 30 lbs. per yard, has the same wearing head and, it is claimed, will leave but 22 lbs. of scrap when worn out, thus effecting a saving of 51 tons per mile. This weight is not only saved at the mill, but in all additional freights and handling.

SALE OF THE BOSTON WEST END ROAD.

THE WEST END STREET RAILROAD COMPANY and the West End Land Company have passed into the hands of the North Shore Traction Company of Philadelphia. This means that Henry M. Whitney retires from the field, and he will now devote his energies to the Dominion Coal Company, of which he is president.

This transfer has been effected within the past week and is the consummation of the comprehensive scheme of the Philadelphia syndicate to control all the electric street railways in eastern Massachusetts. It is the latest development in the most gigantic street-railway deal ever undertaken in this country, and means much to the people of Boston and vicinity. It is the culmination of the consolidation movement begun some years ago, when the Highland absorbed the Union and Charles River Street Railway Companies, followed soon after by the consolidation of the South Boston and Middlesex Roads, and this in turn was followed by the combination of these with the Metropolitan in the great Whitney West End Company. The only street railway then running into Boston and not in the combination was the Lynn and Boston, which was perchased some weeks ago by the North Shore Traction Company, which now controls the whole situation.

The price paid for the West End stock was $85 per share, which is Mr. Whitney's own figure for his holdings.

MISCELLANEOUS.

THE STOREY "SOLENOID" MOTOR FOR DIRECT MACHINE DRIVING.

UNTIL a very recent date the electric motor has simply been used to supply the place of engines and other motive power in operating the ordinary methods of power transmission, that is, by means of shafting and belting. By this means of operating a plant by electricity considerable convenience and economy of space, it is true, has been gained; but the study of electricity by engineers has recently tended toward a more direct application of this power, and the objections generally met in the form and exposure of parts of the ordinary types of motors have made the solution of this problem apparently both difficult and distant. Recognizing these features Mr. I. E. Storey, the inventor of the motor described below, early in 1886, in the mines of Colorado, turned his attention especially to the protective elements necessary to reach a satisfactory solution.

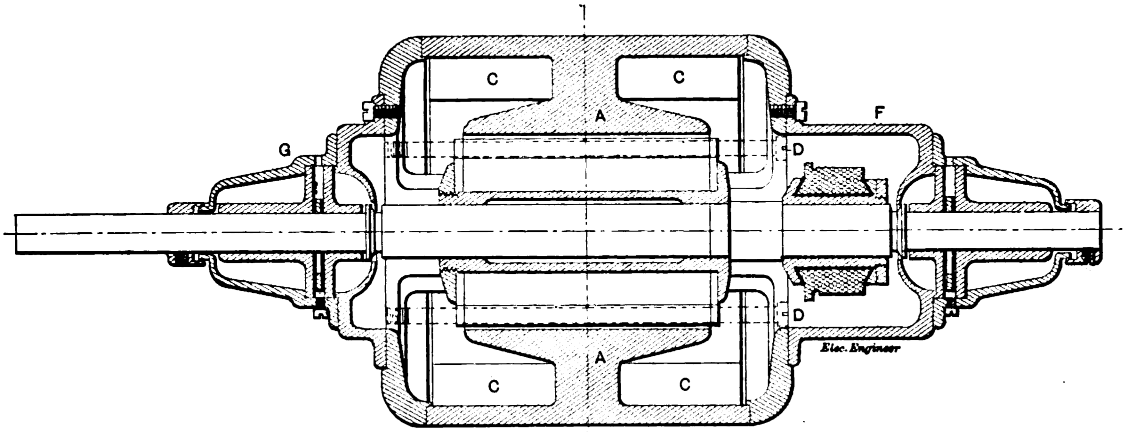


FIG. 1.—STOREY "SOLENOID" MOTOR FOR DIRECT DRIVING.

His first effort in this line was in the production of a motor for the direct driving of a mining drill in which all the ordinary disadvantages of electrical application of power were met under exceptionally difficult conditions, with the added trouble due to the extreme moisture and dirt of all characters common to mining work. This first effort was a complete success and this success led naturally to the consideration of the general adaptation of the to principle to other lines which cannot fail to suggest themselves any intelligent worker whose study has tended at all in this direction. Following out his original intention, the inventor has since produced and patented in the principal countries of the world a type of motor unique in form, of the highest mechanical excellence, possessed of a maximum of electrical efficiency in proportion to the weight of material and entirely free from the common defect, magnetic leakage.

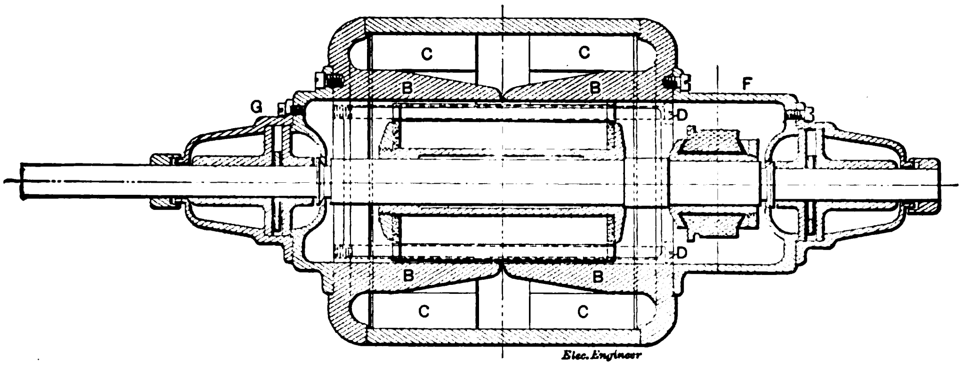


FIG. 2.—STOREY "SOLENOID" MOTOR FOR DIRECT DRIVING.

The motor is a plain cylindrical machine having end projections for the boxes and commutator, and the accompanying engraving, Fig 1, shows a longitudinal section through the T-shaped pole pieces, which project internally from the cylindrical portion of the machine. Fig. 2 shows a longitudinal section through the poles projecting from the end portions, Fig. 3 a cross section through the poles and Fig. 4 a cross section through brush holder and commutator.

A in Fig. 1 represents the cross section of the cylindrical portion as noted above, showing the two T-shaped fields. B in Fig. 2 shows the opposite field pieces carried by the cap ends. C in both drawings represents the cross section and location of the field windings. D are the bolts which are used in assembling the main portion of the magnetic fields.

One of the unique features of this machine consists in the construction of the field magnets, which, as shown, present four poles so arranged that while the centre of the machine is of one polarity the ends are of opposite polarity, both ends being of the same polarity. From this it will be readily seen that while this is a four-pole machine it has eight distinct magnetic circuits, making the path of the magnetic lines uncommonly short and of very low resistance, giving maximum efficiency for minimum quantity of wire. The coils C wound on spools to size, are removed from the spools thoroughly insulated, slip loosely in the cylindrical chamber and occupy a position in a plane perpendicular to the centre line of the shaft and are held in position by the pole pieces A and B.

The armature is of the drum type, toothed. The end caps F G serve for supports, and form the outside chambers for the self oiling bearings. The end cap F carries the brushes which are shown in Fig. 4. The bearings are of peculiar construction and are of such a design that the motor can be placed in any position as long as the centre line of the shaft is horizontal, the end of caps F being protected by a cap projecting over the opening of the box, thereby rendering the boxes impervious to dust and moisture. In cases where there is much moisture these caps are replaced by stuffing boxes. It will be noted that this machine is practically a solenoid and will be known as the "Solenoid" type.

From the above description it will be evident that the motor is practically a hermetically-sealed machine. Thus it is protected on the outside against moisture, dust or any possible external injury, and being entirely enclosed no outside injury can possibly arise from any internal condition incident to the operation of the motor, such as burning-out of armature or fields or sparking at the brushes. These features make the motor water, dust and fireproof, and hence adapt it to an enormous range of work.

The peculiar form of Mr. Storey's motor permits a union of beauty and usefulness in combinations of motor and tool and as an evidence of this, we need only refer to the engraving of a 12-inch upright drill of the friction type which has been in practical use for some months and has been found to fully meet all requirements. An examination of this particular tool, Fig. 5, will readily suggest to the mechanical mind the ease with which this motor can be applied to lathes, planers and other machine tools as well as all types of machinery requiring high and constant speed, notably wood-working machines of all varieties. It is of course unnecessary to enlarge on the many advantages in economy, not only in initial construction, but in maintenance, of an electrically equipped plant, as it is well-known that a properly constructed generator will furnish the power exactly as required, and as tools are shut off, the economy goes direct to the coal bin and power is not absorbed by belts, poorly aligned boxes and consequent friction. It would seem therefore that a motor having all the advantages claimed for Mr. Storey's invention must find a large and increasing field of usefulness.

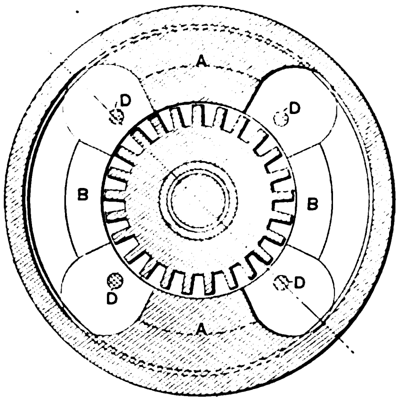


Fig. 3.—View of Field Magnets, Storey Motor—Vertical Section.

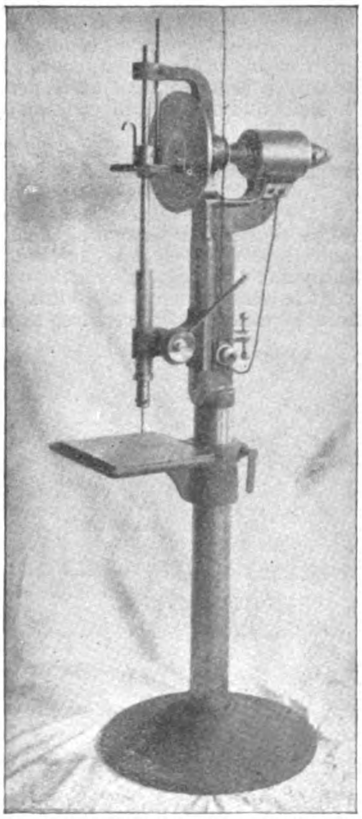


Fig. 5.—12-Inch Drill Direct Driven by Storey Motor.

The manufacturers of this motor, the Hornell Iron Works, Hornellsville, N. Y., are now prepared to furnish motors adapted to grinding and buffing, the operating of drills and small tools and transmission of small power. The Dahl Electric Company, 120 Liberty street, N. Y., are the agents for the manufacturers for the Eastern and Middle States.

THE PRICE OF PLATINUM.[1]

The supply of platinum is in the hands of so few dealers that the real history of the recent rise in the price of this metal is difficult to discover. Until recently the supply of raw ore depended on contracts held from the Russian Government, and, being nearly a monopoly, a diminished output from the mines, together with the rapidly increasing demand for platinum wire in lamp making, as well as the steady consumption for chemical and dental purposes, sent up the price rapidly from $5.50 in 1880, to $10.25 in 1890, reaching no less than $16 25 in June of that year. It seems probable that this price was quite artificial, and it must have fallen rapidly, even if new sources had not been opened. But the sudden collapse in 1891 came as a surprise to those who had accumulated no small stock of platinum, under the impression, no doubt, that the natural supplies were nearly exhausted, or were, at all events, quite unable to meet the demand. The decline has, however, been due to a large extent to the development of mines in British Columbia and although there has been a slight advance lately, the present prices will probably be maintained. The prices given in the diagram are for raw material, and do not include the somewhat expensive process of manufacture. We are indebted to Messrs. W. and J. Jamieson, of Broad street, Golden Square, W., for assistance in compiling these particulars. From 1,000 to 1,500 ounces, have been annually produced from the British Columbia mines since 1886, all from placer mining. From the present hydraulic mining the production can be considerably increased.

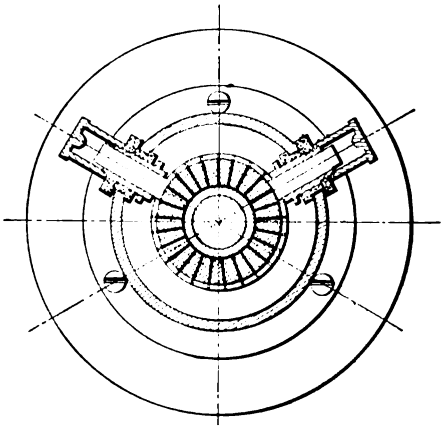
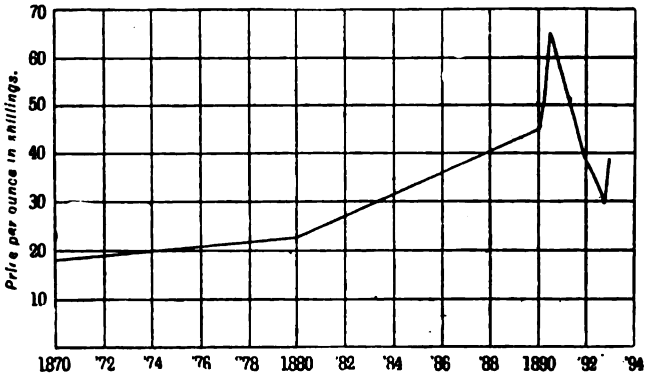


Fig. 4.—Sectional View of Commutator, Storey Motor.



Curve showing Fluctuations in the Price of Platinum from 1870 to the Present Time. These Prices do not include the Cost of Manufacture into Plate or Wire.

The Price of Platinum.

ELECTRIC FIRE LITIGATION.

Some months ago when the Middlesex Theatre, then just finished, in Middletown, was badly damaged by a fire originating from some mysterious cause, it was the belief that the electric wires caused the fire. The sheriff has now served a writ of attachment on the Middletown Electric Light Company in behalf of the Middlesex Assurance Company, which controls the theatre, to recover damages in the sum of $40,000 caused by the partial burning of the building. It is claimed the fire originated through the imperfect insulation of the wires. It is thought that the suit will be carried up to the highest court in the state.

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[1] The London *Electrician*.

THE NEW WESTON STANDARD STATION INSTRUMENTS.

THE appearance of the Weston portable voltmeter and ammeter a few years ago was immediately followed by their adoption as standard instruments by all who were interested in the maintenance of accuracy in their work, whether in the laboratory or in the central station. But while filling all the requirements of accuracy and portability, these instruments were not intended to be used, as they have been in many hundreds of cases, as station instruments for the guidance of the dynamo attendants. For such purposes, an instrument is required which can be easily read at a distance of 50 feet and more, and it was in response to urgent requests from many quarters that Mr. Edward Weston undertook the design of a complete set of standard station voltmeters, potential indicators and ammeters for direct current circuits.

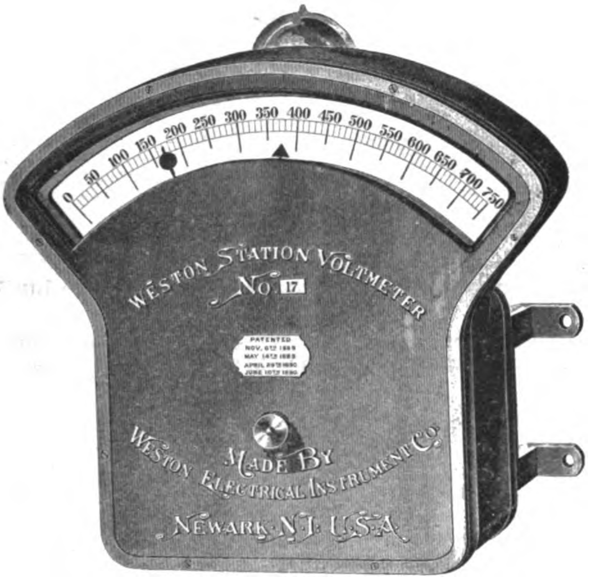


FIG. 1.—WESTON ILLUMINATED STATION VOLTMETER—FRONT VIEW.

These instruments, manufactured by the Weston Electrical Instrument Co., are very fully described in a most comprehensive and highly artistic catalogue just issued from the press of Messrs. Bartlett & Co., and we give below a brief description of the more important ones.

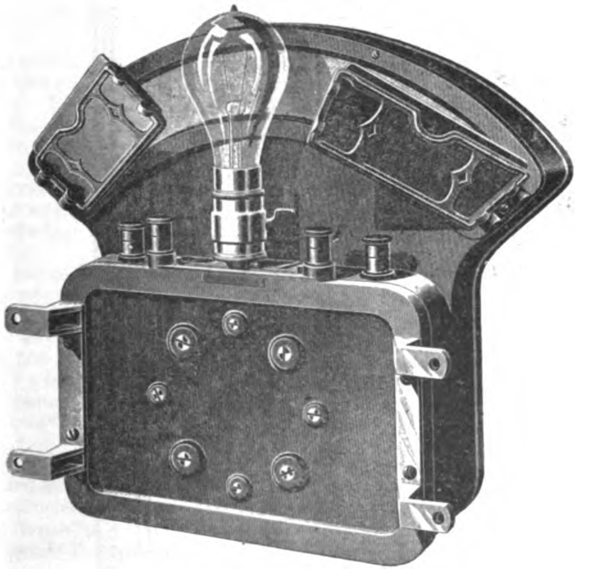


FIG. 2.—WESTON ILLUMINATED STATION VOLTMETER—REAR VIEW.

Figs. 1 and 2 show a station voltmeter with illuminated dial. These instruments are made in two sizes and are similar to and embody the best points of the well-known portable standard direct current voltmeters. They are enclosed in neatly designed dust-proof cast iron cases, which perform the double function of protecting the working parts, and effectually shielding the instrument from the disturbing influence of external fields. They have two indices. One of these is the "indicating index," and has a fine point for close readings, with a blackened aluminum target disc, which, in conjunction with the other index termed the "normal index," enables even a slight deviation from the normal voltage to be seen from a long distance. The "normal index" is inside the case and terminates in a triangular shaped piece of blackened aluminum. This arrow-head index is adjusted from the outside of the case by hand, by means of the knurled knob seen on the front of the case. The index can be turned so that the upper angle of the triangle is at the point of normal voltage, and directly under the blackened aluminum disc of the "indicating index." These are very high resistance instruments, and are consequently extraordinarily economical of power; while the coils are amply large to admit of their being left in circuit continuously without material rise in temperature. They are pivoted and jeweled and are sufficiently sensitive to show a change of one-twentieth of one per cent. in the voltage.

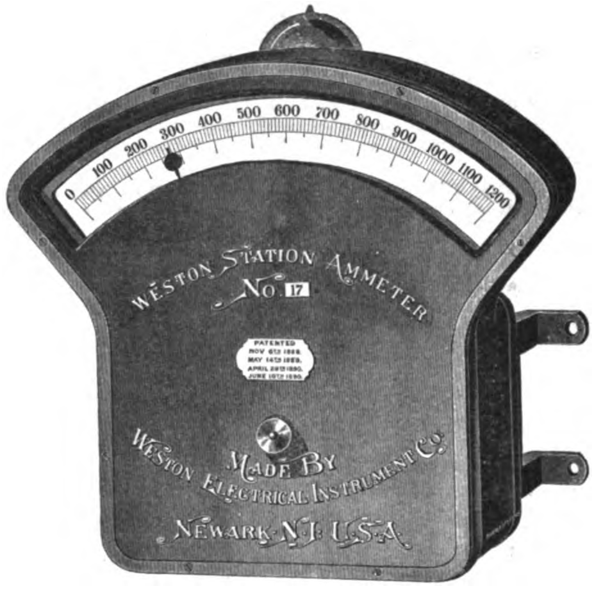


FIG. 3.—WESTON ILLUMINATED STATION AMMETER.

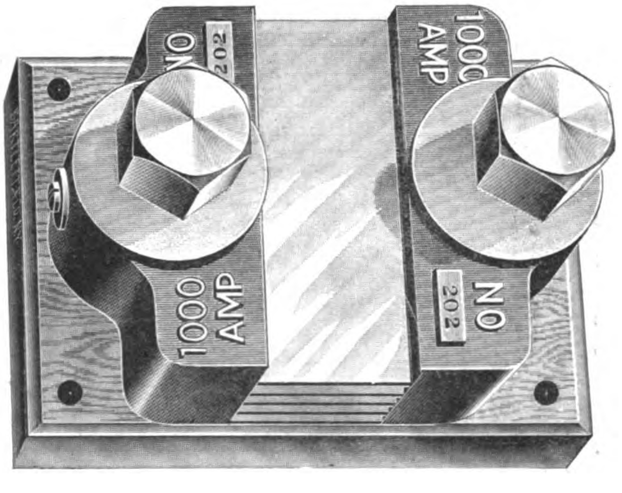


FIG. 4.—SHUNT USED WITH WESTON STATION AMMETER.

The scales are made of opal glass set in a frame in the back of the instrument. At the back of the scale there is placed an incandescent lamp and a pair of mirrors properly disposed to illuminate the scale uniformly from behind, thus making the figures, lines and pointer distinctly visible at a long distance from the instrument.

Fig. 3 shows the illuminated dial station ammeter, which depends for its operation upon the fall of potential between two points of the circuit carrying the main current, and requires a difference of only about .03 volt to give the full scale deflection, at which time it is taking only .07 ampere, no matter what the total capacity of the instrument may be. Unlike the regular portable instruments, the shunt required to secure the necessary fall of potential is not included in the case, but is separate from it, and is designed to be placed at the back of the switch board. In most cases, a special shunt can be dispensed with and a short section of the mains on the switchboard, or the mains leading from the dynamo, can be used instead. In either case, only very thin wires are necessary to carry the extremely small current required to operate the instrument, No. 12 or No. 16 B. & S. gauge being sufficient in nearly all cases. The illuminating device is the same as that for the voltmeter.

The shunt shown in Fig. 4, is of special alloy, mounted on a wooden block, and is provided with large clamping screws for the main conductor and and small ones for the ammeter connections.

It frequently happens that the capacity of a station is greatly enlarged and far beyond the range of the station indicating instruments already in place. Ordinarily, this would necessitate the abandonment of such instruments and the purchase of larger, ones, corresponding to the increased capacity. With the Weston illuminated dial ammeters, however, all this is avoided; for if, at any time, the station capacity should be increased, it is only necessary to recalibrate the ammeter, since by its construction the instrument can be adjusted to any range.

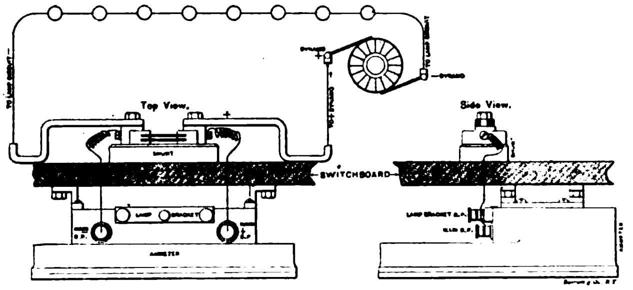


Fig. 5.—Method of Connecting Shunt to Ammeter.

Fig. 5 is a diagram showing the connections between the ammeter and the shunt, and Fig. 6 shows the connection between the station ammeter and the bus bars. The method of attaching them is explained at length in the catalogue.

The central station and isolated plant astatic ammeter, Fig. 7 is provided with a peculiarly shaped field, to utilize as perfectly as it is possible, the magnetizing effect of the current passing through the conductor, and so to secure the most intense field possible for a given length of conductor. These instruments are metal-cased throughout, and are so constructed as to render displacement of the operative parts in relation to each other impossible. They are dust-proof, are well made, and, in common with the other instruments, are provided with sapphire bearings, and have hardened ground and polished steel pivots.

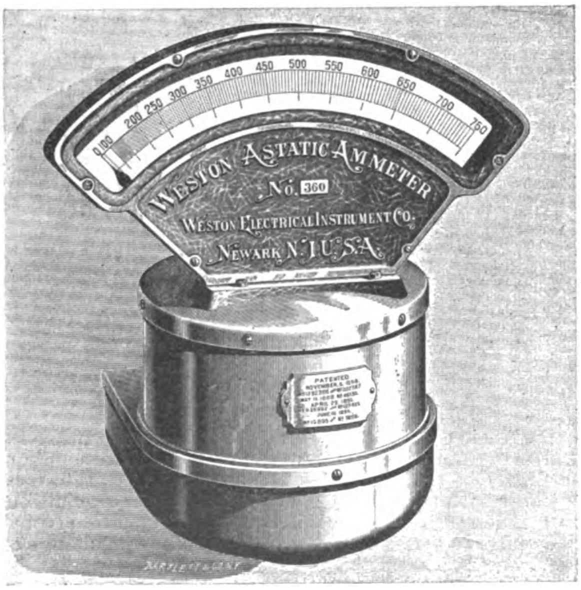


Fig. 7.—Astatic Ammeter.

From this description it will be seen that the Weston Electric Instrument Co., have, as usual, spared no effort to make these latest additions to their already long list of instruments of precision, as nearly perfect as anything of the kind can well be. The catalogue itself is a masterpiece of typography and engraving and contains an excellent introduction on the requirements of electrical measuring instruments.

THE ILLIG ELECTRIC METER.

In order to produce a registering meter for electric currents that would keep an accurate record, and, at the same time, be not unduly complex in construction, Mr. Heinrich Illig, of Bockenheim, Germany, has devised the arrangement of which the accompanying illustration gives, diagramatically, an excellent idea.

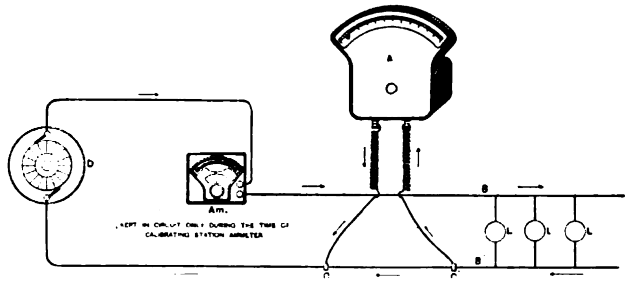
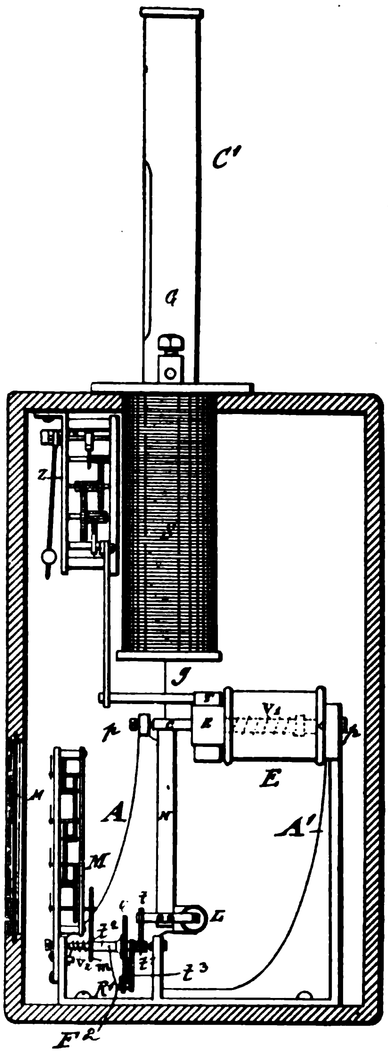

D
Am.
KEPT IN CIRCUIT ONLY DURING THE TIME OF CALIBRATING STATION AMMETER
B
L
L
L
B

Fig. 6.—Method of Connecting Station Ammeter to Bus Bar.



The Illig Electric Meter.

As will be seen, the diagram shows the side of the instrument, the mechanism of which consists of three main parts; the current indicator G, the clock train Z, and a switch device. The current to be measured passes through the current indicator, which is here shown as a spring galvanometer, and then through the solenoid S, to the core of which is fastened the thin wire G, whose upper end extends into the galvanometer and carries an index, and to whose lower end a weight is attached.

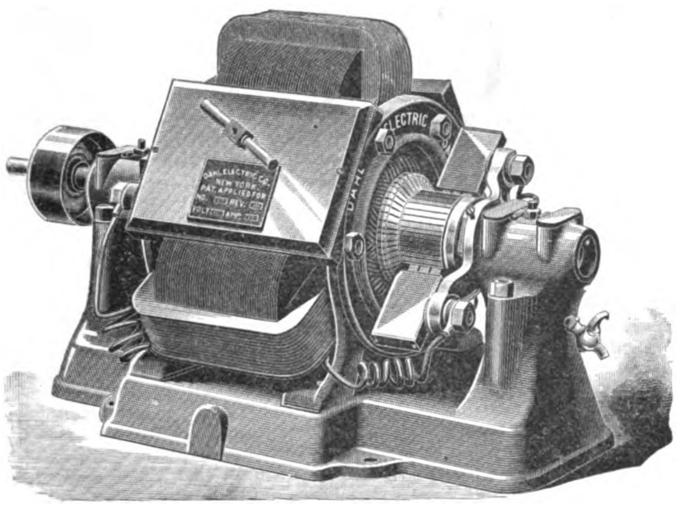
Thus, when the current passes, the index is moved downward and the weight at the lower end of the wire G, descends a proportional distance. When the clock train Z—whose function is to send a shunt current at regular intervals into the electro-magnet E, supported upon the standard A,—now makes a contact, the armature T, is attracted and a lever moves toward the weight carried by the wire G, until stopped by it. The lower the position of the weight, therefore, the greater is the movement of the lever, which is transmitted to the registering device M. The armature T, also continues its motion, and winds up the clock train. As the current is measured at fixed intervals and counted by the register, the quantity can be readily determined.

MOTORS FOR ALTERNATING CURRENTS.

BY

F. H. Leonard Jr

THE alternating system has heretofore been lacking in a very essential feature detracting from the earning capacity of a central station, from which it is operated. We have until now seen in practical operation no motor operated from simple single phase alternating current, which could be termed a commercial success. Many futile attempts have been made to produce such a motor, and the minds of the greatest inventors of this and other countries in the civilized world have been struggling with this knotty problem. Expensive experiments have been made in this country and in Europe on what is now known as the multiphase system, and where cheap power is obtainable motors operated from such a system will no doubt meet with a limited success; but the low commercial efficiency of this system of power distribution, together with the other objections associated with it, prohibits its use where the cost of fuel or power is a matter of any importance.



THE DAHL SINGLE-PHASE ALTERNATING MOTOR.

The use of three wires, which is necessary with the multiphase system, not to mention the added parts of the generator, complicates the system which must be balanced up in much the same manner as the Edison or Hopkinson three-wire system, without gaining the advantage in the reduction of copper, but on the contrary adds one-third to the cost of conductors, provided the same pressure is maintained.

The converters required to operate motors from a multiphase system, must have a capacity enormously in excess of what is actually required in watts to perform the work the motor is calculated for, and when it is desired to operate incandescent lights from the same circuit, a special transformer of complicated form is required, and to operate to best advantage this transformer must have both branches equally loaded.

We doubt if such a system can ever be successfully and extensively introduced into this country, where the simple single-phase alternating system has taken such powerful root, and branched so rapidly and extensively. Consider what such a change would involve. The present generators must be abandoned, the present system of wiring must be entirely remodeled, and a third wire added. The present converter must also follow the generator to the scrap heap, and the system of inside wiring must be remodeled to suit the changed conditions.

We might put up with the change in generators alone, for the sake of adding to our income the revenue to be derived from motors, and complaisantly consider the much evener curve in the ampere output of our central station plant, which would then be earning almost as much during the hours of daylight, as during the hours of darkness; but shall we do the rest—shall we abandon our present system entirely, and go down into our pockets for the price of an entirely new equipment? No! We trust we shall never be compelled to, for already in our dreams we see the ideal central station, which we have every reason to believe will be realized in the near future.

Let us briefly sketch this ideal. A central station operating night and day with practically the same output in ampere hours from 6 A. M to 6 P. M. as from 6 P. M. to 6 A. M., equipped with high pressure boilers, furnishing steam to triple expansion upright engines coupled direct to alternating current generators without collector rings, commutators, or brushes or any moving wire, which, owing to the reduction of iron losses are more efficient than those in use to-day, furnishing a simple single-phase current at a primary pressure, perhaps not materially different from the present standards, except for special long distance transmission, when, by changing armature connections the same generator may produce much higher pressure, or the E. M. F. increased by step-up transformers. The current from these generators transmitted over the same system of distribution as used at present, except where conditions might warrant underground wiring, at the house transformed by a single-phase converter, improved as to regulation and leakage loss, to a safe pressure for commercial and domestic use, furnishing arc lights, incandescent lights and power not only for stationary purposes, but for locomotive purposes in propelling street cars, suburban railways, and even by sections the trunk lines of the country; and not to forget electro deposition by motor generators furnishing direct currents for plating as well as for charging storage batteries.

The key to this happy idealistic situation lies in the production of a practical, simple single-phase motor, which can be connected to any of the present alternating systems, whose lines of distribution penetrate the vitals of so many of our largest cities, weaving a network through its many arteries to its outermost extremities.

Mr. Olof Dahl, of the Dahl Electric Company, has produced such a motor, and a number of them are already in daily use. These motors can be made in any size, from one horse power upwards, are synchronous, hence *must* run at a uniform speed, provided the generator runs steadily, and are self excited, starting themselves vigorously with a torque about equal to their normal capacity. They have a commercial efficiency equal, if not superior to the best direct current motors, the one horse power size having an efficiency of 75 per cent and increasing with the size of motor up to over 90 per cent. There is no undue heating in any of the parts, and neither armature nor field coils rise in temperature more than 30 deg. above the surrounding atmosphere under normal load, and there is no heating of the field cores. Should the armature be stalled, and this does not occur till the motor has 50 per cent. overload, the armature is not injured and no serious heating of the coils takes place, the current being choked back by self-induction.

This motor is designed to operate on the alternating system in use at the present time, without any reduction in the number of alternations, which is called for in the use of the multiphase, involving as it would more expensive transformers, greater in weight proportional to the reduction of alternations.

We can start at once to increase the earnings of our alternating central stations without the slightest change in our system of distribution, from the lines already erected, and from the same transformers used for lighting at night, motors can be operated in the daytime, and both motors and lights at night, if the capacity of the transformer is sufficient.

WORLD'S FAIR TELEGRAPH EXHIBITS.

THE exhibit of the Western Union and Postal companies at the fair will be on the east balcony of Electricity Building. The drawings show a handsome both, 50 feet long and 12 feet high, with six ornamental columns. On the wide cornice will appear the historic words, "What Hath God Wrought" The crude instruments with which S. F. B. Morse, the father of telegraphy, ticked out this message, will be in the booth beneath. They are among the legacies of the Western Union, and are preserved now at the New York offices of the company in a glass case. Beside them will be the perfected quadruplex instruments of the present.

AERIAL RAPID TRANSIT.

MR. A. JATES, of Cleveland, O., has designed an electric motor for an elevated railroad to run from Philadelphia to New York, which he expects will be built and controlled by eastern capitalists. The cars are suspended from an overhead track and hang 20 feet above the ground. It is proposed to make the journey from New York to Philadelphia in little more then half an hour.

PERSONAL.

GENERAL ECKERT CHOSEN PRESIDENT OF THE WESTERN UNION.

General T. T. Eckert.

At the quarterly meeting of the Western Union Telegraph Company held March 8, General Thomas T. Eckert was elected President in the place of the late Dr. Norvin Green, and will continue to act also as general manager until the next meeting of the Board of Directors.

Gen. Eckert has been vice-president and general manager of the Western Union since that company absorbed the Atlantic and Pacific Company in 1881. He had been President of the latter company since 1875. He is nearly 68 years old, having been born at St. Clairsville, O., on April 23, 1825. He was one of the early lot of men who learned telegraphy, and in 1849, when he had been appointed Postmaster at Wooster, O., he was also telegraph operator there. In 1852 he constructed the telegraph line from Pittsburgh to Chicago over the Fort Wayne route. He became the Superintendent of the line and received a more responsible place after that line became a part of the Western Union system.

In 1859 he resigned to carry on a gold mine in Montgomery county, N. C. He was there when the civil war began, but removed to Cincinnati, and in 1862 Gen. McClellan made him superintendent of military telegraphs for the Department of the Potomac, with the rank of Captain and Assistant Quartermaster.

In September, 1862, he was called to Washington, promoted to the rank of Major, and put in charge of the military telegraph headquarters in the War Department building.

In 1864, he was brevetted Lieutenant-Colonel, and then Brigadier-General. He was also appointed Assistant Secretary of War, and retained that place until 1866, when he resigned to become General Superintendent of the Eastern Division of the Western Union Company's lines. He held that place until he became President of the Atlantic and Pacific in 1875.

On January 1, the Western Union Telegraph Company, after their $8,618,509.94 increase of stock, had a surplus of $6,442,693.-17. The estimated returns for the first quarter of 1893, add $1,-675,000 to this amount, from which, deducting interest on bonds, sinking funds and 1¼ per cent. dividend on capital stock issued leaves a net surplus of $6,689,818,17.

EDWARD J. WESSELS.

Edward J. Wessels.

The subject of this sketch, Edward J. Wessels, who has come rapidly to the front in electrical affairs, was born in New York City some thirty odd years ago. He received a common school education, and for seven years thereafter was engaged as confidential clerk for a firm in the chemical trade. Later he carried on the chemical business on his own account. A few years later he sold out his business to the second largest concern in America. He then became a partner in his father's firm and treasurer of the Wessels Company, both being engaged in the West Indian trade, handling fruit and merchandise in a large way.

In 1888 Mr. Wessels sailed with his family for Jamaica, British West Indies, and for three years was head of, and the only member of the firm. He had to manage ten branch offices and despatch eight steamers per month to New York. He developed the Wessels Line Mail Steamers, which carried passengers, but whose entire cargo space was devoted to goods imported and exported by his firm. On his return to his native land he decided to remain among his countrymen rather than to isolate himself and family in what had proved to be exile, for which no pecuniary profit could compensate.

Mr. Wessels retired from business for nearly a year after his return, and then turned his attention to matters electrical, for which he had always had a taste. His first effort was to seek to form a connection with THE ELECTRICAL ENGINEER, but as no interest was for sale he joined the forces of the Short Electric Railway Company of Cleveland, Ohio. He soon developed considerable aptitude for the electrical business, and as their General Eastern Agent closed many important contracts. He not only sold apparatus, but devoted attention to financial matters, and was entrusted with delicate negotiations.

At Mr. Wessels' own request he severed relations with that company on the 31st December last, on its absorption by the General Electric Co., after having made an enviable record. He had intended going actively into the street railway field, but preferred to abandon his intention, on discovering the "true inwardness" of some franchises. He has just parted with his interests in the New Brunswick City Road, after finding that the City Council would not permit him to substitute electricity for horses except upon certain terms repugnant to him.

Mr. Wessels is connected with a few clubs, but is essentially a family man, and when not away on business trips, is to be found at his attractive home in Westfield, New Jersey. He is president of the Advance Club of that place.

Mr. Wessels has just become interested in the Curtis Electric Manufacturing Company on the commercial side of the business.

Indomitable energy, tact, and rare ability have won for Mr. Wessels a host of friends. We predict for him a great future and the Curtis Company is to be congratulated on having him become identified with them. The Company have an excellent street railway motor equipment, recently illustrated and described in these pages, and already giving admirable results on more than one road.

Mr. J. E. Zeublin, acting general superintendent has now been appointed general superintendent of the Chicago Telephone Co., with headquarters in Room 21, Telephone Building, 203 Washington Street, Chicago. Mr. Zeublin has a host of Eastern friends. He was formerly with the Western Union in Philadelphia and Washington, and subsequently general western superintendent of the Baltimore & Ohio Telegraph Co.

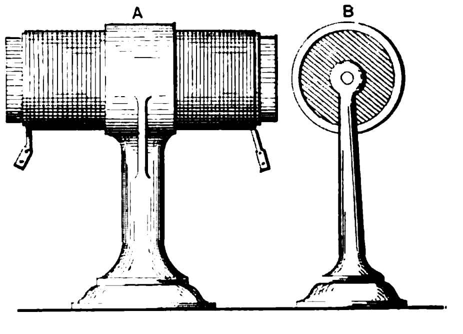
Mayor Lee Mantle, of Butte, Mont., just appointed to the vacant United States Senatorship, from Montana, is an old telegraph operator, formerly employed on the Utah Northern Railroad. He is wealthy, and owns the controlling interest in the Butte *Inter-Mountain*.

LETTERS TO THE EDITOR.

SINGLE PHASE ALTERNATING MOTORS.

My attention has been called to an article appearing in your valuable journal, on "Non-synchronous Motor for Ordinary Alternating Currents,"[1] by C. E. L. Brown.

I beg to state that motors of the kind he describes were not unknown to the art, as a reference to my United States patent No. 407,844, filed Nov. 17, 1888, will show. In fact I sent to the Paris Exposition of 1889 a small single-phase alternating current motor with arrangements for starting, which motor was built in accordance with the principle pointed out by Mr. Brown, as arising from his own observations. Not long after I made my experiments which led to the transformer motors, I found that such a motor could have its armature coils kept on short circuit and run in either direction after a start had been given to it. The original motor had a single inducing or field circuit, and an armature with three coils and a commutator, similar to that of a Thomson-Houston arc machine, and connected, movable, straddling brushes whereby the period of short circuiting of the arm-



Experiment Illustrating the Principle of Single Phase Alternating Motor.

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[1] The Electrical Engineer, Feb. 8, 1893.

ature coils could be increased after starting to include the whole period, and maintain them on closed circuit.

This was followed by the construction and working of many such machines with different arrangements of winding and means for starting. I have no hesitation in saying that had it not been for the comparatively high frequency of alternating currents in use, namely 125 to 130 per second, a large extension of the use of such motors would have taken place by this time in the United States.

The motor on this principle which was exhibited at Paris in 1889, was described in a number of the technical journals at the time. It had a commutator which was only used in starting. The rotating part had its coils connected with the commutator, and the brushes at starting were included in the alternating current circuit driving the machine in series with the inducing field. At a fairly good speed a centrifugal device inside the commutator short circuited the segments and placed the revolving coils thereby on a maintained short circuit, and the motor at once speeded up to nearly synchronism. Even at 125 periodicity the motor was efficient, the only drawback being that its weight output was less than could have been obtained with lower frequency.

The principle of such single-phase motors may be illustrated very prettily as follows: In the accompanying illustration let A be a coil with iron-wire core energized by alternating currents so as to produce an alternating field, and let B be a wheel made up of iron discs at the centre around which is a rim or band of copper overhanging the edges of the discs. This wheel is mounted on pivots and started in rotation mechanically in either direction. After this it will increase in speed and torque up to a certain point, depending on the frequency of the currents in A and the friction to be overcome. That the direction of motion is indifferent may be shown by turning the wheel on a vertical axis so as to present to the pole the opposite end of a diameter. The rotative action I have formerly described as being due to translation lag, that is, a lag due to the traverse of a conductor conveying current past the pole, whereby the action of the current in that conductor becomes displaced in the direction of motion and produces a moving field, the iron mass or body tending to accommodate itself to the direction of the lines in the moving field.

ELIHU THOMSON.

LYNN, MASS.

ALTERNATE CURRENT MOTOR DESIGN.

IN his paper before the National Electric Light Association, Dr. Louis Bell took the ground that two and three-phase alternate current motors without any accessory appliances may be made entirely satisfactory and that the criticisms to which they have been subjected are not justified. In this he is at one with the European builders of such motors, but he is strangely at variance with them in his judgment of the motors that have actually been built. The motors as built are those upon which the European engineers rely to prove their claim, and these motors are in Dr. Bell's opinion improperly designed.

According to Dr. Bell the no load current of a 10 h. p. motor should not be more than about 25 per cent. of its full load current and the energy component of the full load current should be 88 or 90 per cent. Now the figures recently published by the Oerlikon engineers for such a motor as representing their present practice, show the no load current to be 29 per cent. of the full load current, and the energy component of the latter to be 62 per cent. The first figure does not differ much from that of Dr. Bell, but, of course, its importance depends very largely on the magnitude of the second ratio, which differs widely from that associated by Dr. Bell with good design. That Dr. Bell, with the resources of the General Electric Company at his disposal, has much surpassed the Oerlikon engineers, is possible; but if so, it is to be hoped he will follow their example by publishing a detailed statement of his results. It must be borne in mind that Mr. Brown and his successors have had great experience with this class of machinery and their ability is unquestioned. On re-reading the report of Dr. Bell's paper I see that he does not claim to have achieved results superior to the Oerlikon work; he merely states that motors giving such results must be badly designed. Has he any tests of well designed motors to publish?

Granting Dr. Bell's claims as to the magnitude of the lagging currents at full and no load I must take issue with him as to their importance. Dr. Bell speaks as if, when the energy component of the full load current amounts to 88 or 90 per cent. of the whole, the only effect of the lagging current is to require an increase of some 11 to 14 per cent. in the size of transformers, line conductors and generators. Were this so, I think it would still be worth attending to, but it is only a small part of the matter. When the energy component of the current is represented by 88 or 90 per cent. of the whole current, the lagging component is not 10 or 12 per cent., but 43 to 47 per cent. But as the current lags it demagnetizes the generator, and the percentage of the lagging component measures the demagnetizing effect of the armature. In this case it would be equal to that of a continuous current armature of the same ampere turns in which the brushes had a lead of 26 degrees. It may be said that however great the demagnetizing effect of the armature may be, it can be overcome by compounding the field. But suppose the angle of lead to be variable? This is the condition we have to work under, for the ratio of the lagging component to the total current varies with every change in the motor load. It is as if we had to compound a continuous current machine with a variable plane of commutation. Anyone who has ever worked such a machine will pity the alternate current engineer striving for regulation with lagging currents.

Another point that Dr. Bell appears to overlook is that motors do not generally run at either full or no load but at some intermediate point. Now, at intermediate loads the proportion of lagging current is greater than at full load, increasing with the decrease in load. A motor will be kept running as long as there is any work for it to do, no matter how small a fraction of its capacity. But, protests Dr. Bell, at low loads the ratio of the energy component to the whole current is very small. In this very fact lies the trouble for the station manager, for his customers will insist on meters measuring only the energy component,—the Thomson wattmeter for example. He will thus be paid in such cases for only a small fraction of the current he furnishes. I am aware that Dr. Bell will contend that the wattless current costs nothing to generate and therefore does not concern the station manager; but he will have a hard time convincing any station manager of experience that he is right. Were the coal consumed the only element of cost in producing current he, indeed, would be, but this is far from being the case.

I have pointed out above that it actually requires a larger plant to generate a given wattless current than an energy-bearing current of the same magnitude, because of the demagnetizing effect of the former. Therefore, until Dr. Bell has something more positive to offer us, than his opinion as to what constitutes good design, I shall continue to believe in the necessity of appliances like condensers for neutralizing the lagging component of motor currents. To those, like Prof. Forbes, who are interested in the problem of distribution of power by alternate currents I would say they will find a practical example here in Pittsfield.

JOHN F. KELLY.

PITTSFIELD, March 10, 1893.

GIVING A GENERATOR STEADY SPEED.

THE inquiry in your current issue XV., No. 252, p. 219, March 1893, for a means of giving a generator steady speed from a source whose speed is variable seems charmingly indefinite. If the source be an engine, it would seems as though the *best contrivance* to adopt would be a new engine. Should the source be a water wheel, the case might not require so radical treatment.

Let us have the conditions fully stated so that intelligent suggestion can be made, and no doubt it will be forthcoming.

J. STANFORD BROWN.

NEW YORK CITY, March 4, 1893.

OBITUARY.

DEATH OF MR. J. E. H. GORDON.

MR. J. E. H. GORDON, who for many years has taken an active part in the developement of electric lighting in England, recently met while out riding, with an accident which terminated fatally. Mr. Gordon was educated at Eton and Cambridge. He graduated in 1875, and then had the great advantage of spending a year under Clerk Maxwell in the Cavendish Laboratory. In 1880 he published his extensive work under the title of "A Physical Treatise on Electricity and Magnetism." Its distinguishing feature consists in the numerous abstracts which it contains of the most important contemporary researches. In 1884 this work was followed by a "Practical Treatise on Electric Lighting;" and from that time Mr. Gordon devoted his knowledge and untiring energy to establishing and superintending electric installations. For two years (1878-79) Mr. Gordon acted as assistant secretary of the British Association, and in 1881 he was one of the English delegates to the Paris Electrical Exhibition.

D. HERBERT JEFFERY.

IT is with sorrow we record the death of D. Herbert Jeffery, secretary of the Crocker-Wheeler Electric Company, which occurred on the second instant, from pneumonia, after a brief illness of ten days. Though Mr. Jeffery was but 41 years of age his business career had been a wide and varied one. He was born at Corning, N. Y., and in the early years of the sewing machine business became connected with the Remington and Wheeler & Wilson companies, later turning his attention to the hardware trade with the firm of Sargent & Company, of New York and New Haven. Mr. Jeffery subsequently assisted in the organization of the New York Live Stock Express Company and was for several years its secretary. Mr. Jeffery was also one of the three originators of the large corporation known as the Domestic Spring Bed Company, of Jersey City, N. J., from which he afterwards withdrew and with his brother, established the firm of Jeffery & Company, Jeisey City, maufacturers of wire springs. He subsequently sold out his spring business to accept the secretaryship of the Crocker-Wheeler Electric Company, with whom he has been connected for the past two years.

D. Herbert Jeffery was well-known in musical circles of New York. He sang in several of the churches of the city, and was connected with a number of its choral societies. His numerous friends always found him of an extremely loyal and generous disposition, ready to give freely of his bountiful store of musical talent in the cause of charity.

LEGAL NOTES.

INCANDESCENT LAMP LITIGATION.—EDISON ELECTRIC LIGHT COMPANY vs. BEACON VACUUM PUMP AND ELECTRICAL COMPANY.

In the United States Circuit Court in Boston, before Judge Colt, a motion was made on Tuesday March 7, by counsel in behalf of the Beacon Company for a stay pending an appeal to the Circuit Court of Appeals from the interlocutory order granting a preliminary injunction in behalf of the Edison Electric Light Company. Mr. Witter contended that by the provisions of the statute of March 3, 1891, under which the appeal is to be taken, it had been until recently a question whether a defendant was not as a matter of right entitled to a stay, even of a perpetual injunction, pending such appeal, upon filing a bond in a sum to be fixed by the court to secure the complainant against loss by reason of such suspension of the injunction. It had been held by the Circuit Court of Appeals in three different circuits that under the statute an appeal could be taken from an interlocutory decree in a patent suit, even after a final hearing granting a perpetual injunction and directing an accounting. But in a very recent case the Supreme Court had held that while the statute seemed by implication to mean that the stay of the injunction is a matter of right, there was no express provision to that effect, and hence that until the matter was made clear by legislation, the opposite construction must prevail. But counsel argued if Congress intended to provide that an injunction should be stayed pending an appeal, and by the use of inapt language has failed to do so, it was at least a weighty reason why the Court should exercise its discretion and stay the injunction in this case, unless the circumstances were such that the injury would be greater to the complainant than the continuance of the injunction would cause to the defendant. If defendants were not entitled to the stay, as a matter of right, it was nevertheless undoubtedly within the discretion of the Court to stay the injunction pending an appeal, and under the circumstances of the present case such a stay ought to be granted. It clearly appeared from the affidavits now filed that a much greater hardship would result to the defendants if the injunction was not stayed, than to the complainant if the injunction was stayed. The new defense in the present case called into serious question the validity of the patent in suit. The prior use of the invention by Mr. Goebel was asserted by defendants in the evidence of more than 50 witnesses. The Court had held that defendant had not proven this use beyond a reasonable doubt. Entertaining the highest respect for the decision of the Court it nevertheless seemed to defendants as if the case was peculiarly one in which different Courts might entertain different opinions and reach different conclusions, and if so this was a weighty reason why this Court should exercise its discretion and stay the injunction during the short time required to obtain a decision on appeal in the higher Court.

Mr. Fish, in reply stated that he did not see what the plea of the Beacon Company having gone into the business of the manufacture of pumps had to do with the case, that the Beacon Company knew well the state of the lamp litigation when they went into the business, that they were infringing the lamp patent; and he asked the Court to allow matters to remain as they were. He claimed that the General Company were not behindhand in their orders, that they had a right to choose their customers, and that they must protect their business.

Mr. Brandeis then spoke as to the irreparrable loss which the Beacon Company would sustain, were the Court of Appeals to reverse the court's decision, should the Beacon factory in the meantime remain closed.

Judge Colt then decided that the plantiffs had not advanced any testimony of such useful weight as to influence his previous decision. Hardships are common in all cases of injunction, and if courts were to take this into consideration, injunctions would never be granted. That was not law. If a patent is established, the patentee is entitled to the right of injunction being served on infringers, and he saw nothing in this case to take it out of the rules which govern in such cases. He maintained that the Beacon Company knew well the state of litigation when they went into the business in May, 1891, that they took the risk, and that they now must suffer the consequences. In conclusion he said it would be a failure of justice on his part if he were to assist in taking away from the Edison Company the benefits to be accrued from the few months remaining to the patent, after years of litigation, and in view of the recent decision of the New York Court, and Circuit Court of Appeals, who had already firmly sustained the patent in question. The motion for stay was denied.

The American Bell Telephone Company has obtained one month further in which to file its answer to the new government suit against it, to annul the Berliner patent.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED FEBRUARY 21, 1893.

Alarms and Signals :—

Low Water Indicator for Boilers, W. H. Rodgers, Bay Side, New York, 492,236. Filed June 21, 1892.

Electric Bell Alarm, G. L. Réenstierna, Boston, Mass., 492,309. Filed Oct. 12, 1892.

Electric Burglar Alarm, J. Kamsler, New York, 492,330. Filed Dec. 15, 1892.

Dynamos and Motors :—

Multipolar Dynamo Electric Machine Armature, G. E. Dorman, Chicago, Ill., 492,920. Filed Jan 4, 1892.

Employs a core having circular rests at its ends and a series of elliptical coils placed upon the core parallel with the axis, and having their ends bent on to the rests.

Dynamo Electric Machine, W. E. Freeman, Long Island City. 492,151. Filed July 8, 1892.

The armature consist of a core wound longitudinally with wire in sections of three layers each, the inner layers wound in one direction and the outer in the opposite direction, and the intermediate layers having their wires connected.

Commutator for Dynamos or Motors, J. A. Williams, Cleveland, O., 492,176, Filed May 2, 1892.

A commutator so constructed that a blast of air from within may be continually kept up between the commutator bars.

Method of Constructing Armature Cores for Electric Motors or Dynamos, A. W. Smith, San Francisco, Cal., 492,244. Filed Feb. 20, 1892.

An armature core built up of sectors of sheet iron and continuous rings which are afterward welded together electrically at the points of least magnetic flow.

Commutating Apparatus for Dynamo Electric Machines, E. J. Houghton and W. White, London, Eng., 492,291. Filed March 26, 1892.

A commutator brush consisting of layers of wire gauze arranged in a box, a spring acting to advance the box, a pressure plate bearing against the layers and a screw acting on the pressure plate.

Magnetic Core for Armatures, T. H. Hicks, Detroit, Mich., 492,355. Filed Oct. 6, 1892.

An armature core constructed of cast metal, provided with outstanding collars at its ends and wound with magnetic wire.

Lamps and Appurtenances:—

Cut-out for Incandescent Electric Lamps, T. A. Edison, Llewellyn Park, N. J., 491,992. Filed Nov. 12, 1891.

Claim 1 follows :

The combination with an incandescent electric lamp, of a cut-out device therefor, having a movable member situated in the path of entrance of air to the vacuum globe upon the destruction of the seal.

Pole Standard for Arc Lamps, F. D'A. Goold, Schenectady, N. Y., 492,008. Filed April 15, 1892.

Duplex Electric Arc Lamp, B. B. Ward, New York, 492,124. Filed May 17, 1892.

A multiple carbon lamp having two or more independent regulating mechanisms and corresponding simultaneously burning pairs of carbons, two or more corresponding field controlling magnet systems in continuous operative connection with the electric circuit, and a frame common to said pairs of carbons and magnet systems.

Process of Coating Conductors for Incandescent Lamps, T. A. Edison, Menlo Park, N. J., 492,150. Filed Oct. 26, 1882.

Process consists of heating the filament in contact with a mass of insulating material by means of which some of the material is fused on the filament.

Electric Arc Lamp, H. Harper, London, England, 492,200. Filed July 10, 1891.

Employs a tubular magnetic dash-pot surrounding the holder for the upper carbon, a solenoid surrounding the dash-pot, and a stationary piston arranged within the dash-pot.

Electric Arc Lamp, H. Harper, London, England, 492,201. Filed July 10, 1891.

Invention consists in means for regulating the feed of the carbons, the method of constructing the solenoid coil to adapt it for use with alternating currents and means for enabling the carbons to be readily fixed and accurately centred.

Hanger for Electric Incandescent Lamps, S. O. Larkins, Blair, Neb., 492,215. Filed Feb. 17, 1892.

Electric Arc Lamp, J. Thompson, New York, N. Y., 492,312. Filed May 17, 1892.

Claim 1 follows :

In an arc lamp, a carbon holder and means for moving it longitudinally, combined with another carbon holder and its supporting rod or rack, a lever carrying said rod or rack and means for moving said carbon holder substantially parallel to said lever to feed the carbon forward.

Miscellaneous :—

Workman's Time Recorder, F. H. Bolte, Milwaukee, Wis., 491,978. Filed, Aug. 6, 1892.

Manufacture of Chlorates of the Alkaline Metals and Metals or the Alkaline Earths. H. Gall, Hermes, and A. de V. De Montlaur, Paris, France, 492,003. Filed July 21, 1892.

Has for its object to improve the electrolytic process of producing the chlorates of the alkaline metals.

Electrical Indicator, H. J. Haight, New York, 492,011. Filed June 1, 1892.

An electrically operated weather vane indicator which may be placed at any distance from the vane.

Automatic Circuit Breaker for Motors, R. T. Lozier, New York, 492,036. Filed Apr. 4, 1892.

Electric Elevator, F. E. Herdman, Indianapolis, Ind., 492,160. Filed Mar. 8, 1892.

An electric elevator employing an automatic brake.

Lightning Conductor and Arrester, A. B. Lyman, Cleveland, O., 492,219. Filed Oct. 28, 1892.

Invention consists of two vibrating arms with carbon ends, and a central lever connected with the arms and having an armature operated by an electro-magnet.

Magnetic Tool, J. F. Standiford, Muscogee, Ind. Ter., 492,245. Filed July 14, 1892.

Electrical Foot Warmer, W. E. Ulmer, Hoquiam, Wash. 492,247. Filed April 27, 1892.

Railways and Appliances :—

Electric Motor and Controllimg Apparatus for Cars, J. V. Capek, New York, 491,982. Filed Nov. 14, 1891.

Employs an armature in sections, one section being fast to the shaft and the second free to rotate upon it under the influence of the field magnet

Electric Railway Trolley, A. Dickinson, Darlaston, England, 491,988. Filed Feb. 9, 1892.

A trolley adapted to rotate radially in any direction.

Conduit Railway, F. B. Rae, Detroit, Mich. 492,106. Filed Apr. 11, 1891.

Employs a conduit having a series of well holes in its bottom, with insulated supports mounted in them and extending upward into the conduit; the sections of the trolley wires having their ends connected to said suppports.

Conduit Electric Railway, F. W. Brann, Oakland, Cal. 492,265. Filed May 16, 1892.

Employs an A shaped roof made of non-conducting material and secured to the conduit frames out of line on one side, and a second interior non-conducting strip secured thereto with intervening non-conducting plates.

Coupling for Trolley Wires, W. H. Keckeley, Covington, Ky., 492,301. Filed Dec. 10, 1892.

Consists of a case having tapering ends into which the wires are inserted and wedges in either end adapted to bind between the wire and the case and held in position by the strain upon the wire.

Telephones and Apparatus :—

Magneto Telephone Switch, W. Humans, Cambridge, Mass., 492,019. Filed July 23, 1885.

Automatic Individual Telephone Call Apparatus, J. Sack, Berlin, Germany, 492,110. Filed Sept. 18, 1891.

Invention relates to apparatus by means of which the called-up station may be readily connected with the transmitting station while the other stations in the circuit are entirely disconnected.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

OVER 5,000 H. P. HARRISBURG IDE AND IDEAL ENGINES SOLD IN ONE MONTH.

W. R. Fleming & Co., of New York and Boston, representing the Harrisburg Foundry and Machine Works, report that they have closed in the past few weeks the following contracts : Two tandem compound Ideal railway engines, 1,000 h. p. for the Electrical Association, Boston, Mass.; two tandem compound Ideal railway engines, 1,000 h. p., for the Montreal Street Railway Company, Montreal, Que.; one tandem compound Ideal engine. 500 h. p., Taunton Electric Light Company, Taunton, Mass.; two Ideal engines 375 h. p. for Jos. Edwards & Company, New York, N. Y.; two Ide engines 200 h. p. for direct coupled lighting work in the Houston street station, and two Ideal engines 175 h. p. for electric light service in the 50th street station, for the Broadway & Seventh Ave. Railroad, New York, N. Y.; two Ideal engines, 150 h. p. for the Stewart Building, New York, N. Y.; two Ideal engines, 75 h. p. for the Mail & Express Building, New York, N. Y.; one Ideal engine, 75 h. p. Meyenberg Corporation, Hoboken, N. J.; one Ideal engine, 60 h. p. General Electric Company, Boston, Mass.

In addition to the above the Harrisburg Works are busy on contracts they have closed in the territory not controlled by W. R. Fleming & Company, among which are the following; three Ideal tandem compound engines, 1,000 h. p., including boilers, Weitmeyer settings, and complete installation of power plant, for Irwin Electric Light & Power Company, Irwin, Pa.; one 125 h. p. Ideal tandem compound engine and boiler, with Weitmeyer setting, including erection of complete power plant, at Phœnixville, for the Eastern Engineering & Construction Company, of Philadelphia, Pa.; one 80 h. p. Ideal engine, for DuBois & Van-Tassell, DuBois, Pa.

THE MICA INSULATOR COMPANY.

The Mica Insulator Company filed articles of incorporation March 1, 1893, at Elizabeth, N. J., the authorized capital stock being placed at $100,000, all paid in. The company's plant is located at Schenectady, N. Y., while its office and salesroom will be at 218 Water street, New York city. The officers are Eugene Munsell, president; Franklin Brooks, vice-president, and Lewis W. Kingsley, secretary and treasurer. The company will manufacture micanite for electrical insulation, a description of which has appeared in our columns.

Through an ingenious patented process controlled by this concern, small scrap mica is now utilized in all forms and shapes for insulating purposes where sheet mica was formerly used, at a much reduced cost, and with no diminution in efficiency. The material is excellent, and, properly used in dynamos, motors, etc., is destined to prove an extremely valuable addition to a not too long list of first-class insulations.

WESTERN NOTES.

The Ansonia Electric Co., corner Randolph St. and Michigan avenue, Chicago, formerly The Electrical Supply Co., make a specialty of the Edwards electric door opener and constantly carry a large stock of them. This opener is well known to the trade, and many of the best contractors will use nothing else for the reason that it is very compact, is suited for either right or left hand doors, and no amount of pressure against the door will prevent it from being opened as easily as when there is no pressure. This feature of the opener is one which is controlled and used in this opener only. The Ansonia Electric Co. also manufactures the Diamond Carbon Battery and finds that the demand for it is continually growing, giving the best of evidence that the battery is what it is claimed to be—"Second to none."

E. Ward Wilkins, of Partrick & Carter Co., Philadelphia, did not attend the St. Louis Convention to sell goods, but just wanted to meet old friends and let them know that he is still very much alive; he couldn't resist the temptation to stop at Chicago on the way home, and see if any first-class hotels were being built to accomodate World's Fair visitors—knowing that if such was the case they must have Partrick & Carter Needle Annunciators as a part of their electrical equipment. As he came home with orders for one 300 Number, and two 150 Number Annunciators it may be assumed that there will be some first-class World's Fair hotels. The pocket testing buzzer he had with him must be a good thing, as he took orders for 700 of them.

The Electric Appliance Company will shortly acquaint the trade with the merits of their latest specialty, the Eddy windlass. This windlass has several new and valuable features which easily recommend it as an improvement. It is so arranged that the windlass is automatically locked by the removal of the crank and released when the crank is replaced. The lock is such that it prevents the windlass from being tampered with in any way, and yet does not require any accessory as a padlock and key, which are always a source of continual annoyance. The locking mechanism is so arranged that it cannot be affected by sleet and ice.

The Central Electric Company of Chicago are putting on the market a porcelain socket without a screw, (with the exception of the necessary binding screw). All the parts are thoroughly and well made, and it is especially recommended to construction men on account of its simplicity in wiring. Both wires can be cleaned an equal distance from the cordknot, thus insuring the socket hanging plumb. As a fixture socket, it is a very neat device, and deserves a wide sale.

The Vincennes Electric Light and Power Co., Vincennes, Ind., recently held its annual meeting and re-elected the present directors, and H. W. Frund, general manager. Officers' reports show one hundred per cent. increase in business, and $20,000 new machinery installed during past six months. This company has one of the cleanest and finest equipped plants in America.

The Great Western Manufacturing Company, of Chicago are making arrangements to install machinery and furnaces for drawing wire in their Duluth works. The capacity designed at present is 20,000 lbs. per day. It is expected that this will be in working order by the first of September.

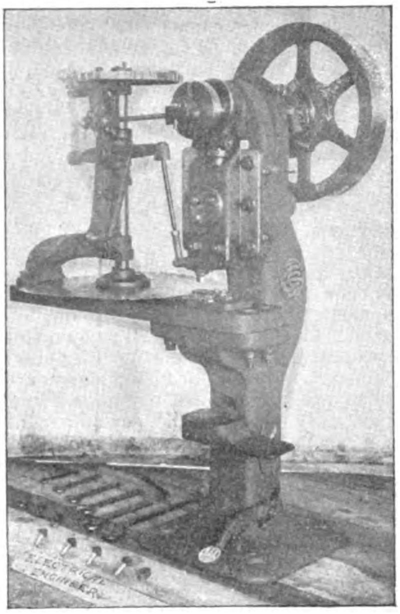
F. R. Dravo & Company, Pittsburgh, representatives of the Ball Engine Company, Erie, Pa., have the contract for furnishing the new Horne building of Pittsburgh, with two 100 h. p. Ball engines.

The Hammond Street Railway, Hammond, Ind., is approaching completion. The steam plant was furnished by the Chicago office of the Ball Engine Company, 506 The Rookery.

The Austin Electric Light Company, Austin, Minn., are about to install an 80 h. p. tandem compound Ball engine, built by the Ball Engine Company, Erie, Pa.

The Sawyer-Man Company has applied for its dissolution as a corporation. The Westinghouse Company is now making stopper lamps for itself, and as the Sawyer-Man Company has been placed under injunction, through no fault of its own—it prefers to wrestle no longer with adverse circumstances.

THE INDEX FERRACUTE CUTTING PRESS.



Index Ferracute Cutting Press.

The rapid increase in the production of electric motors naturally stimulates the invention of improved devices for making the several parts which comprise a motor. The Ferracute Machine Co., of Bridgeton, New Jersey, makers of presses and dies for sheet-metals, have recently placed upon the market a press, fitted with an indexing attachment, for the purpose of facilitating the production of the notched armature discs which form so important a part of the ordinary electric motor. These discs have until recently been made either by having an expensive pair of dies for cutting out the notched disc entire, or by notching the circles, one notch at a time, by hand. The latter method is of course slow and inaccurate.

By means of the machine above mentioned, shown in the accompanying illustration, the manufacturer has only to provide the circular discs, place them in proper position between the dies, press the treadle, and the machine does the notching, cutting one, two or three notches at a time, and running the disc around automatically until completed. Its capacity is for discs from 4 to 30 inches in diameter, and with any number of notches from six upward, as required. With it are usually furnished a set of seven dials, which will cover all the low numbers of notches, and a good many of the high one. Extra ones, with other numbers of teeth, can however be made to order at small expense.

This machine is so arranged that the dial can be adjusted around upon the shaft after the first piece of work is set, so as to bring the starting notch in exact relation to the key-seat, holes or other locating devices in the disc. It has a positive locking pawl which prevents over-running by momentum, and a number of other valuable improvements never used before in presses of this kind. One excellent feature is the using of a large diameter of dial, with the consequent accuracy obtainable, for any kind of work which has a number of notches agreeing with it, or some divisor of that number. This is accomplished by setting the dial overhead, so that it can extend over the ram of the press, thus differing from those usually made which are obliged to have the dial considerably smaller than the work. With these a small dial having a certain number of teeth is not of much use for large work with the same number of teeth, or a divisor thereof, because of the inaccuracies due to wear, etc., as well as to the lost motion being magnified by the leverage.

The whole indexing attachment is quickly removable, so that the press can be used for all kinds of other work, in which case it becomes the standard Ferracute punching press, already fully described in The Electrical Engineer.

SALES OF BALL ENGINES.

Messrs. J. W. Parker & Company of 38 South Fourth street, Philadelphia, Pa., eastern representatives of the Ball Engine Company of Erie, Pa., report the following recent sales and construction: At Scranton, Pa., The Blakely & Dickson Street Railway Co., 1,000 h. p. improved railway engines, together with the necessary boilers, sheet iron stack and entire construction; road to be in operation by July 15; Tampa, Fla. Electric Railway & Power Co., one 200 h. p. improved railway engine—the cross compound type; Pottstown, Pa., Electric Light, Heat & Power Co., one 250 h. p. cross compound engine; Campbell Creek Coal Co., Malden, W. Pa., one 80 h. p. engine, together with boiler and entire construction; Elkton, Md., Electric Light and Power Co., one 80 h. p. engine, together with boiler and entire construction; Mt. Carmel, Pa., Edison Electric Illuminating Co., one 100 h. p. engine and boiler, a duplicate of an order given 18 months ago; Bloomsburg, Pa., Electric Light & Power Co., one 100 h. p. engine; Milton, Pa., Electric Lighting Company, one 100 h. p. engine; Lehigh Coal & Navigation Co., Lansford, Pa., one 100 h. h. engine; Oxford, Pa., Electric Light & Power Co., two 100 h. p. engines; Midvale Steel Co., Nicetown, Pa., one 125 h. p. engine. This company has very recently finished the construction of several very fine steam plants and additions to several others, among them 300 h. p. at Bethlehem, Pa., 200 h. p. at Scranton, Pa., 1,000 h. p. for the North Hudson Elevated Railroad at Hoboken, a 50 h. p. and a 200 h. p. isolated plant in Philadelphia. They have their entire force at work, report inquiries very numerous and anticipate the best year in their history. The large railroad plant at Scranton is one of the largest orders given out this year, and they think it a rare compliment to the merits of the Ball engine, and the splendid construction of engines due to the careful workmanship and highest grade of materials used by the Ball Engine Company of Erie.

THE FELDKAMP ELECTRIC MOTOR.

The accompanying ingraving, Fig. 1, represents, a new motor just brought out by the Electrical Piano and Motor Company, which embodies a novel design in the construction of the field magnets. As will be seen the field is created by two coils the cores of which are bolted to side pieces on which the pole pieces are cast directly. This makes the magnetic field a short one. The bearings for both pulley and commutator end are carried by arms cast directly on the magnetic frame and thus afford ample bearing surface for the shaft journals. These motors are built in sizes varying from ¼ to 75 h. p. and for all circuits up to 500 volts.

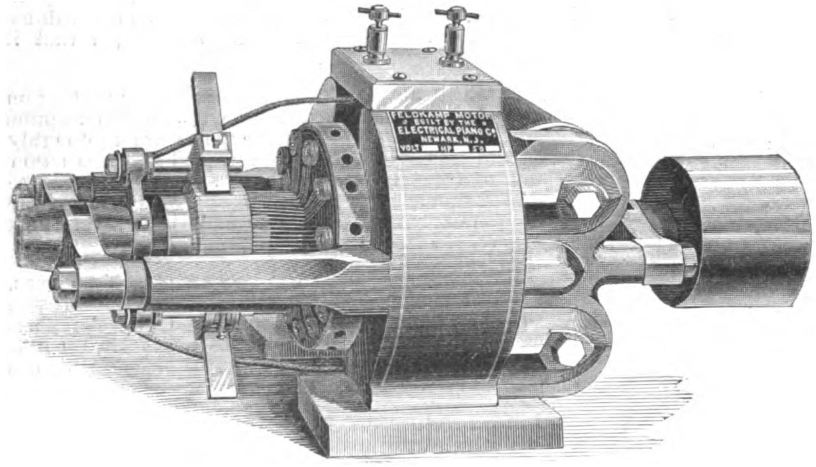


Fig. 1.—Feldkamp Motor.

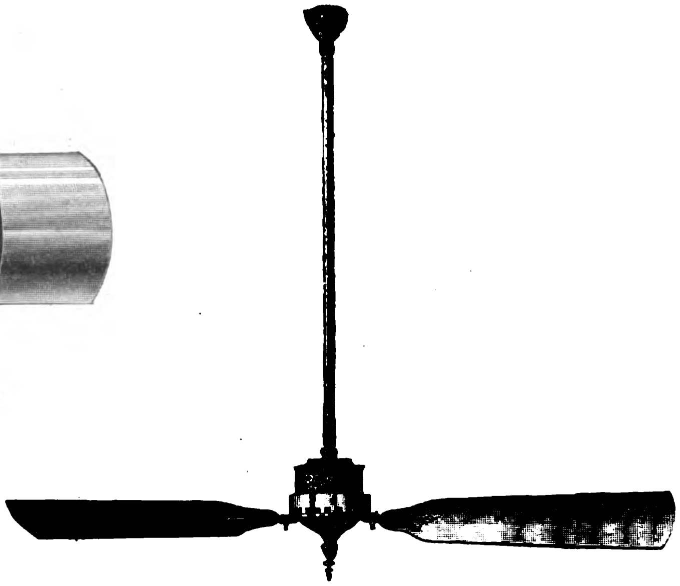


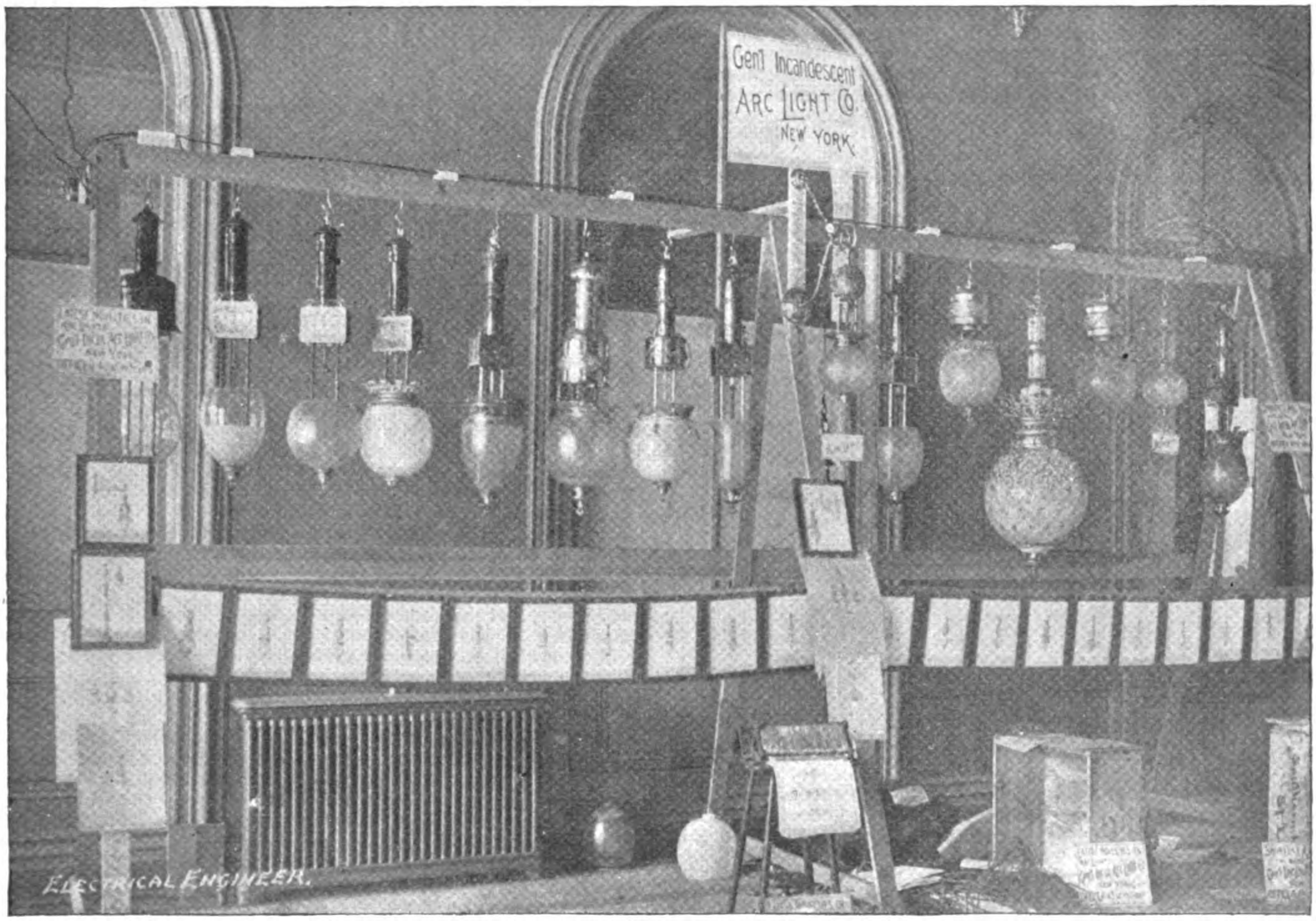
Fig. 2.—New Ceiling Fan Motor.

The engraving, Fig. 2, shows a ceiling fan also built by the company, intended to operate on 110 volt circuits. One of the valuable features of its construction lies in the fact that it is so built and insulated that even if the fan is held stationary with full current on the motor cannot be burnt out. This feature will be appreciated when one considers the frequent accidental prolonged stoppages of such fans when current is full on.

Both the motor and fan outfit above described are now being handled by Mr. Wm. C. Callmann of 591 Broadway, New York, who is the sole agent for them.

THE ST. LOUIS EXHIBIT OF THE GENERAL INCANDESCENT ARC LIGHT COMPANY.

One of the prettiest and most effective of the exhibits at the St. Louis Electric Light Convention was that made by Mr. Augustus Noll, in behalf of the General Incandescent Arc Light Company, and here illustrated. The cut is interesting, as showing a collection of lamps in a great variety of styles, but alike in type and construction. The display embraced lamps of all candle powers, sizes and designs, from the "Bijou," which require five amperes per pair, to the "Mogul," which is rated at 2,000 c. p. The lamps are made in designs like those used in gas or incandescent light brackets and chandeliers. Their light is soft, silent and steady, and they can be safely used for all lighting purposes. They are constructed in strict accordance with the rules and regulations of the Board of Fire Underwriters, both poles being insulated. The lamps can be trimmed by any novice, and the carbons can be renewed without taking off the globe. As was indicated by the exhibit, special designs in arc light chandeliers or posts, two or three in series, can be ordered at reasonable rates. The criticisms made on the exhibit were very favorable, taking the shape of a large number of orders.



St. Louis Exhibit of the General Incandescent Arc Light Company.

The president of the company is Mr. S. Bergmann, well known as a pioneer electrician and manufacturer of electroliers. The concern has very large works at Thirty-third Street and First Avenue, New York City.

HABIRSHAW INSULATION.

To those contemplating the purchase of insulated wires or cables, it will be of some interest to read the following extract from a letter recently received by The Ansonia Electric Co. (formerly The Electrical Supply Co.), Chicago:—"We average from 3,300 to 4,000 volts in our circuits, and during the entire period of our use of Habirshaw insulation, we have never had a single burn-out, or ground, on any of our underground circuits, many of which are constantly immersed in water; in fact our underground service has given greater satisfaction than we had expected, and have every reason to attribute it to the superior quality of the Habirshaw cables which we use. As an evidence of our experience with your cables, we have placed an order for immediate shipment for five miles more of the Habirshaw cables for underground work, some of which will displace other cables." The above letter was written several months ago, and as still another evidence of satisfaction, the same company again orders over five miles of special Habirshaw insulation.

HOUSTON, STANWOOD & GAMBLE.

Mr. Charles R. Houston of Cincinnati, was in New York last week for three or four days. Mr. Houston's firm, Houston, Stanwood & Gamble make a self-contained slide-valve engine that has found much favor in electrical, as well as other circles. In their own city they have 100 h. p. in the *Enquirer* office, part of which runs the lighting plant, besides which they have their engines in the Morgan Power Company's station, and in the generating room of the Cincinnati Street Railway Company. To mention their sales in Cincinnati alone would look like printing a city directory.

On each engine the name plate, H. S. G, not only reminds one of the manufacturers, but calls attention to three qualities of the engine—"Heavy, Strong, Generous."

A LARGE SCHIEREN BELT.

Messrs. Chas. A. Schieren & Company of this city have recently made for the Reading Electric Light Company of Reading, Pa., a belt composed of the best parts of the hides of 300 steers. This belt is 130 feet long, 50 inches wide and is made of three thicknesses of leather: It will transmit 1,000 h. p. and weighs 1,483 pounds.

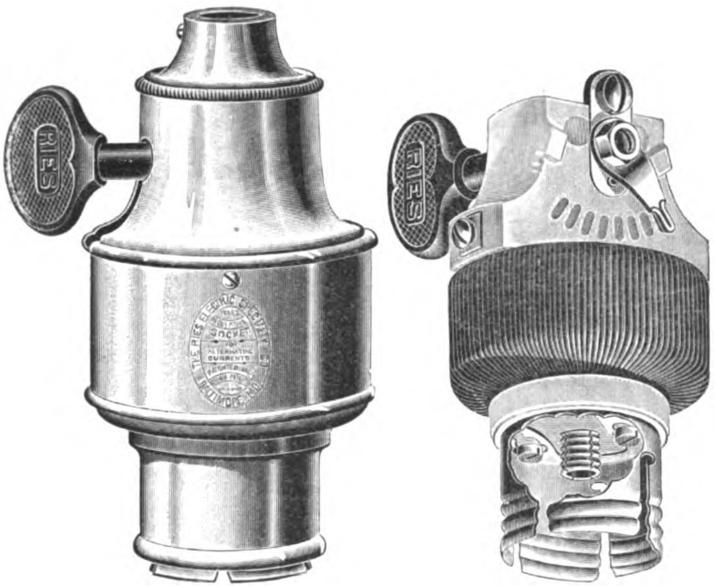
The Jenney Electric Motor Company of Indianapolis, Ind., have been obliged to open a branch office at Chicago, where they will at all times carry a full stock of motors and generators of standard sizes. Mr. A. H. Goode, well known in electrical circles, has been appointed special agent in charge of the Chicago office at No. 932 Monadnock Building.

THE RIES IMPROVED UNIVERSAL BASE REGULATING SOCKET.

Like many other pioneer inventions, the Ries regulating socket, has, since its first introduction, made rapid strides toward final perfection. As it is now being manufactured by the Ries Electric Specialty Company, of Baltimore, Md., it embraces a number of important improvements, that render it far superior in every way to that first placed upon the market.

By referring to Figs. 1 and 2, which show an outside and inside view of the improved socket, respectively, it will be seen that the socket comprises among other things, the base or lamp-holding portion proper, the reaction coil by means of which the opposing or regulating counter E. M. F. is generated, the insulating block or support containing the contacts representing the coil terminals, the operating key, switch arm and binding screw connections for the leading-in wires, and the enclosing shell, the latter made in two separable parts.

The mechanical problem of providing an effective, permanent, and thoroughly safe and reliable supporting block that would permit of making the necessary frictional connections between the contact pins and the delicate terminal wires of the reaction coil, was one that presented numerous difficulties. After several preliminary experiments with wood, hard fibre, and various moulded compositions and also with porcelain, lava, glass and other insulating materials of a non-yielding or vitreous nature. Mr. Ries finally succeeded in devising a porcelain block, together with a method of making the necessary contacts therein, so constructed as to fully and satisfactorily meet every requirement. It is probably safe to say that no other electrical device requires so exact and intricate a porcelain part, or demands so high a degree of uniformity as this block.



Figs. 1 and 2.—Ries Improved Universal Base Regulating Socket.

The reaction coil used in this socket is probably one of the most perfect in existance. It consists of a small finely laminated annular iron core 1¼-inch wide and ¾-inch high, built up of very thin specially treated iron rings, carefully assembled and taped. This core is evenly and skillfully wound by hand with a silk insulated cable composed of seven separately insulated copper wires varying from each other in size according to the maximum current that each is required to carry, the wires being of different colors to facilitate their proper connection. The ends of this cable, after it is wound upon the core, are bared and the extremities of the individual wires, each with part of its insulation removed, are threaded through a double series of holes in the porcelain supporting block, in such a manner that when the copper contact or terminal pins are driven home and clinched at the back of the block, all of the several wires of the cable are connected in series, the winding being divided by the contact pins into seven sections of equal length.

The operating key of the socket, which has its bearing in the porcelain block and projects through an opening in the enclosing shell, is provided with a contact arm that moves over the series of terminal pins on the working face of the block; thus, when the length of wire in series with the lamp filament is reduced, the self-induction in the wire due to the presence of the iron core, is diminished and more current is allowed to flow to the lamp, thus increasing its brilliancy. When the arm is moved in a direction to increase the active length of wire in series with the lamp, the self-induction or counter electromotive force set up in the copper wire is increased, thereby permitting a proportionately smaller current to flow to the lamp, causing a diminution in the light.

The operating key moves through an angle of 90 degrees and its position indicates the extent to which the lamp is turned on. The contact pins are slightly depressed below the hardened glazed face of the porcelain block, so as to form a seat for the end of the contact arm and thus insure its proper electrical engagement with the pins and prevent accidental displacement. This arrangement also prevents all possibility of short-circuiting and consequent heating of a coil section that might otherwise be produced by the bridging of two adjacent terminal pins.

It will be noticed that several important advantages are gained by the peculiar construction of the counter E. M. F. coil, to which the remarkably high electrical efficiency of the socket as well as the comparative simplicity of its manufacture are due. First, the magnetic circuit is very short, unbroken and of exceedingly low resistance, producing a core of the most perfect type and permitting a high degree of induction with the least possible amount of iron or copper. Second, the seven wires comprising the coil are wound upon the core simultaneously, and in such a manner that each wire is distributed evenly around the core at the same uniform distance, so that the entire core is uniformly energized by and as uniformly reacts upon, each active section of the winding, whether only one or the entire number of wires composing the cable are in circuit. Third, the winding is so proportioned with respect to the maximum current flowing through it at the different stages of light and with respect to the iron core, that a very low and practically uniform C^2R. loss per unit length is obtained and a maximum induction produced in the iron core throughout nearly the whole range of regulation.

The winding of the socket is so arranged that when the light is turned down to its lowest stage the filament burns at a dull red, emitting just sufficient light to enable one to see the lamp and locate its position upon entering a dark room, and to turn it up to the desired point without having to first strike a match or feel around for it among the electroliers or other fixtures of which it forms part. When the lamp is burning at this stage on an ordinary 50-volt alternating current circuit (the lamp being of standard 16-candle power), it will consume just $\frac{1}{5}$ of an ampere at an E. M. F. of 10 volts, or a total energy of two watts, as against 50 watts when burning at its normal candle power. In other words, the lamp under these conditions is consuming only $\frac{1}{25}$ of its normal energy, not including certain minor losses.

Heretofore it has been necessary in ordering sockets of any type to specify the particular make of lamps for which they were desired, or to carry in stock a varied assortment of sockets adapted to the leading makes of lamps. This is now obviated by the new universal base shown in Fig. 2, with which the improved sockets are provided. It will be observed that the centre contact is a hollow slotted stud provided with the standard Thomson-Houston lamp-thread upon its outer surface, its interior being the proper diameter to receive the centre pin of the Standard Sawyer-Man or Westinghouse base lamps, while its exposed end is arranged to bear against the centre disc of the standard Edison lamp base. The slots in the projecting portion of the centre stud give it sufficient elasticity to make good electrical contact and to accommodate itself readily to variations in the diameter of the contact pins or threads that are often found in lamps of different makes. It is also capable of a slight vertical movement to accommodate variations in lamp bases. The stud is of square cross section where it enters the porcelain washer and has a milled end that fits into a rectangular opening in the stem of the porcelain insulating block that passes through the centre of the reaction coil, thus effectively locking the stud and preventing it or the washer from turning.

Surrounding the centre stud is a combination spring contact cup, held to the washer by two screws which enter corresponding threaded holes in a brass terminal ring that is located in an annular depression formed in the opposite face of the washer. This combination cup is so designed as to fit lamps with Edison, Westinghouse or Sawyer-Man base. For lamps of the Thomson-Houston pattern this contact cup is dispensed with, the centre stud and contact screws alone being used. The cup is provided with two slotted holes of such shape that it can be readily slipped out or inserted at any time by simply loosening the screws that hold it and without removing them from the washer. The sockets are also furnished with the regulation contact cups for either Edison, Sawyer-Man or Westinghouse bases, or without cups for Thomson-Houston base lamps, for either 50 or 100 volt alternating current circuits.

It is of course obvious that while the socket can only be used as a *regulating* socket on alternating circuits, the total ohmic resistance of the winding on the reaction coil is so low that it does not make an appreciable difference in the brilliancy of the lamp if used on the continuous current circuit. This fact in itself proves that the regulation of the light is not due to resistance, as has been alleged by those unfamiliar with its construction.

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THE
Electrical Engineer.

VOL. XV. MARCH 22, 1893. No. 255.

NON-SYNCHRONOUS MOTORS FOR ORDINARY ALTERNATING CIRCUITS.

BY

E. Arnold,

(*Chief Engineer, Maschinenfabrik Oerlikon*)

THE basis for the construction of non-synchronous alternating current motors has been known for some time by the experiments of Elihu Thomson and the work of Nikola Tesla, but the practical carrying out of these machines has been prevented by numerous difficulties; and only since the comprehensive experiments in the construction of multiphase motors, has the way been cleared for non-synchronous single-phase motors of which a number are already in regular operation.

Elihu Thomson has shown that if a certain initial speed be imparted to a rotatable conductor, placed in an alternating magnetic field, it assumes of itself an increased velocity of revolution, if placed non-symmetrically with respect to the magnetic field, and shows a tendency to increase this speed. If in place of simple massive conductors there is substituted an armature of laminated iron which carries a number of short-circuited windings of copper bars, the action is considerably increased; the armature then attains an almost synchronous speed, and can be braked without decreasing materially the number of revolutions. Experiments coincide exactly with what is stated by Mr. C. E. L. Brown on page 135 of the issue of Feb. 8 of THE ELECTRICAL ENGINEER.

An alternating current motor built on this principle therefore consists of an induced system of windings, the latter being generally rotatably mounted, and comprising so-called short-circuited armature windings, some of which are short-circuited individually or in groups, commutator and brushes being altogether absent. The direction of rotation of such motors is determined by the initial velocity, which must be imparted to the motor.

A method of this kind well worthy of attention is laid down in the U. S. Patent, No. 401,520, of Feb. 18, 1889, granted to Nikola Tesla. The exciting coil is divided into two sections of different self-induction. To start the motor the two sections are coupled in parallel; in consequence of the difference in phase of the currents in the two sections a rotary field is established, the motor starts, and in a very short time attains a nearly synchronous number of revolutions. The second winding may now be entirely cut-out and connected in series with the first. It may be of interest here to reproduce the claims of the patent; diagrams may be omitted here as the illustrations, Figs. 12, 13 and 14, accompanying Mr. Brown's article coincide exactly with the patent claims of Mr. Tesla. These claims are as follows:

Claim 1. The method of operating an alternating current motor herein described by first progressively shifting or rotating its poles or points of greatest attraction and then, when the motor has attained a given speed, alternating the said poles as described.

2. The method of alternating an electro-magnetic motor herein described, which consists in passing through independent energizing circuits of the motor alternating currents differing in phase and then, when the motor has attained a given speed, alternating currents coinciding in phase as described.

3. The method of operating an electro-magnetic motor herein described, which consists in starting the motor by passing alternating currents, differing in phase, through independent energizing circuits and then, when the motor has attained a given speed, joining the energizing circuits in series and passing an alternating current through the same.

4. The method of operating a synchronizing motor which consists in passing an alternating current through independent energizing circuits of the motor and introducing into such circuits a resistance and self-induction coil, whereby a difference of phase between the currents in the circuits will be obtained and then, when the speed of the motor synchronizes with that of the generator, withdrawing the resistance and self-induction coil, as set forth.

Claims 2 and 3 are especially characteristic.

That Mr. Tesla, as far as is known, has not succeeded in constructing a good alternating motor is due to the magnetic arrangement which in his motors is characterized by prominent, salient poles. The reason for this may be explained as follows: In No. 3 of the *Electrotechnische Zeitschrift* of 1893, it was shown, in an article by the writer, that in two coils placed at right angles to each other which move synchronously in a stationary alternating magnetic field, alternate currents are induced, the periodicity of which is double that of the exciting current and the phase of which is shifted ¼-period in one with respect to the other. The windings evenly spaced around the circumference of a short-circuited armature we may consider from one instant to the next to be replaced by two such windings. If we examine the magnetic fields which create the currents induced in these coils, then, at low saturations, one of the fields is proportional to the current strength

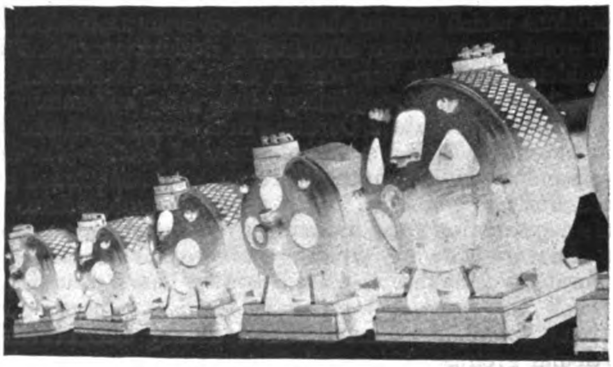


FIG. 1.—OERLIKON MOTORS FOR ALTERNATING CIRCUITS.

$$\frac{H f p}{R} \sin^2 pt,$$

and the other proportional to the strength,

$$\frac{H f p}{R} \cos^2 pt.$$

In these formulæ,

H = maximum intensity of the magnetic field, which is assumed to be homogeneous, and which is created by the exciting coil;
f = area of one winding of the armature;
R = resistance of the same;
$P = 2\,n$, where n is the number of periods of the exciting current. The two magnetic fields 1 and 2 have the tendency to combine into a rotary field of constant strength, which is proportional to the amplitude

$$\frac{H\,f\,p}{R}.$$

We obtain an ideal rotary field which, when the movement of the armature is synchronous, turns in an opposite direction to the angular velocity.

If the angular velocity of the rotary field, and hence that of the armature, is retarded, then the differential action between the primary magnetic field and the rotary field tends to maintain the synchronism. A magnetic disposition which favors the existence of the rotary field, and presents the smallest possible magnetic resistance is evidently one to be sought for, and this is the case when the armature is surrounded by a mass of iron as continuous as is possible; that is to say, markedly prominent teeth and poles are to be avoided. In the field magnet, as in the armature, a small air gap between the field and the armature iron with the wires embedded between narrow teeth or in holes, therefore fulfils all requirements.

The arrangement first indicated by Wenström with toothed and hole armatures which have been largely adopted in continuous and alternating current practice, and which is also used by Mr. C. E. L. Brown, may be successfully applied to alternate current motors. The conditions which govern the design of a multiphase motor hold good for ordinary alternating current motors. The coincidence goes so far that a multiphase motor may be converted into one for ordinary alternating currents.

The Maschinenfabrik Oerlikon in the course of the last year has worked out a standard series of motors for both single and rotary alternating currents, and introduced both successfully in practice. Both types of motors have the same construction; the inducing winding which surrounds the armature is a ring winding; the armature sheets are perforated, and the insulated copper bars which pass through the holes are either soldered to a copper ring common to all, or short-circuited among themselves in particular groups.

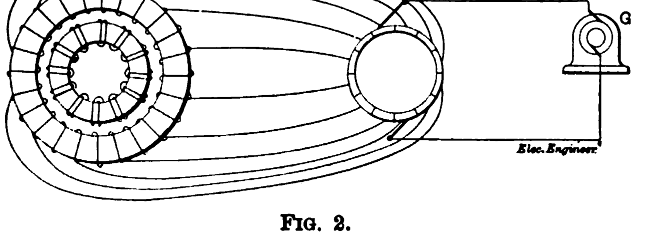


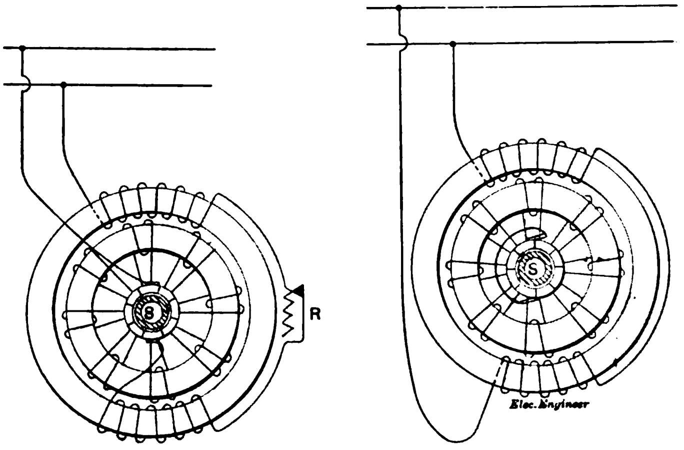
FIG. 2.

The engraving, Fig. 1, made from a photograph, shows the type of motor constructed in sizes of from ⅛ to 6 h. p. The larger motors embody a different construction for the journal bearings, and are built in a stronger manner. The rotary current motors are built in sizes of from ⅛ to 50 h. p. A non-synchronous motor of 250 h. p. has been in operation for a number of months driving the Oerlikon factory, the power being obtained from Hochfelden. The non-synchronous motors for ordinary alternating currents are built in sizes from ⅛ to 9 h. p., and the data respecting them is given in the accompanying table:

TABLE OF OERLIKON ALTERNATE CURRENT MOTORS, 110 VOLTS, 65 COMPLETE PERIODS PER SECOND.

Size in Horse Power	⅛	¼	¾	1½	2	3	4	6	9	
Revs. per min...	1800	1800	1800	1780	1750	1750	1900	1175	1150	R.p.m.
Watts consumed	230	370	950	1780	2240	3160	4040	5810	8300	Watts
Efficiency in per cent.	40	50	58	62	66	70	73	76	80	%
Length } of	370	375	445	485	515	540	600	790	860	m. m.
Breadth } base	320	320	380	455	455	840	840	1185	1185	m. m.
Total Height....	360	410	450	505	505	605	675	840	900	m. m.
Pulley { Diam...	190	190	140	140	160	160	250	250	250	m. m.
Pulley { Width..	60	60	80	80	100	100	190	140	160	m. m.
Weight.........	93	110	220	275	330	506	605	930	1210	lbs.

In the town of Chur where the Oerlikon Company has installed an alternate current central station, a two h. p. motor has been in operation since last December running off ordinary alternating circuits, and driving the presses of the *Neue Bündner Zeitung*. In the same place a 1½ h. p. motor is employed in a butcher shop, and a nine h. p. motor serves as a starter for a 100 h. p. synchronous motor in the mill of Messrs. Lundi & Parly in Chur.



FIGS. 3 AND 4.

The Oerlikon Company makes use of a number of methods for the starting of their single phase motors. The method of Tesla, although simple, has the disadvantage that heavy currents pass though the motor when starting, which, in consequence, requires comparatively large transformers, and the connection of small motors to lighting circuits is thus accompanied with difficulties. Small motors, however, can be so constructed that starting by hand suffices to bring up to a speed with a small current, after which the load can be thrown on.

Another method of starting such machines, Fig. 2, consists in carrying out the field winding and connecting the same to commutator segments in the same way as is done in continuous current motors. As the commutator remains stationary the latter can be attached to the motor or to the switchboard. The current is led to the field windings by means of two brushes which bear upon the commutator. In order to start the motor the brushes are revolved; by this action the axis of the magnetic field created in the motor is displaced, corresponding to the rapidity of the brushes, and a rotary field is thus created which starts the motor. As soon as the motor has reached a certain speed the rotating brushes may be fixed in any position.

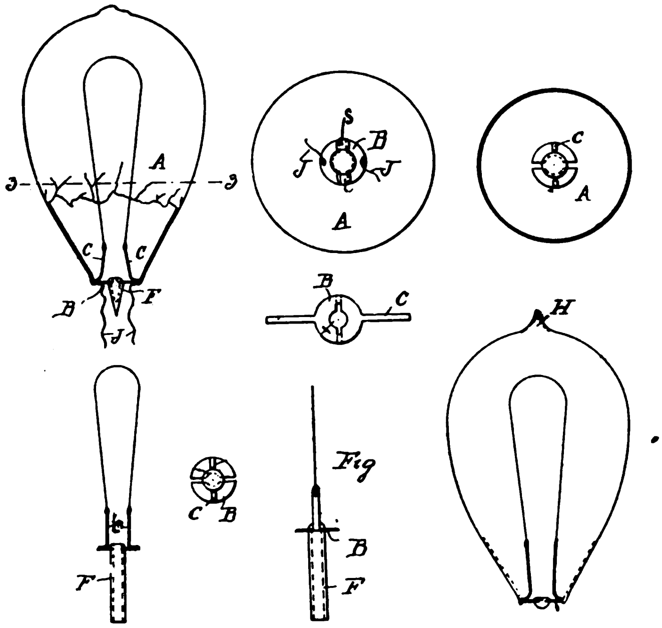
Finally, the writer may mention another method for which he applied for a patent last year, and which coincides exactly with that of Mr. C. E. L. Brown, and illustrated in Figs. 17 and 18, page 137 of the Feb. 8 issue of this journal. The following is an abstract from the patent:

"A Gramme ring, Figs. 3 and 4, may be assumed to be the form of armature; as in the continuous current machine the individual coils are connected with the segments of the commutator upon which bear two brushes. When starting, a primary current is led not only to the field but also to the armature. With the brushes correctly placed, the alternating current motor now works like a series motor with continuous current. The maximum current in the armature is always coincident with the maximum field, and the motor will start with torque. The resistance R included in the circuit allows the current and the torque to be regulated. As soon as the armature reaches synchronous speed, which takes very little time, the commutator segments are short-circuited upon themselves. This is accomplished by means of an insulated ring S mounted upon a shaft, which can be shifted, and which is pressed against the commutator segments by means of a lever. The current now goes from one brush to another. There is no sparking, and the armature operates like a short-circuited armature. By employing a short-circuiting device, the brushes can be raised entirely from the commutator after starting; by means of a centrifugal governor, the cutting in and out of a short circuit can be accomplished automatically, etc."

THE VON DER KAMMER INCANDESCENT LAMP.

In all incandescent lamps heretofore made, the leading-in wires pass through a considerable length of glass at the lamp base. When the lamp is broken, therefore, these long thin pieces (usually of platinum) must be melted, refined and re-drawn for subsequent use, involving expense, deterioration and loss. This has all been avoided in a lamp recently designed by Mr. John von der Kammer, of Chicago, in which the leading-in wires are replaced by plates of platinum applied at the base of the lamp in such a way as to dispense with the seal pieces, stems, glass tubes and glass wire supports usually employed, and also with the necessity of fusing glass to glass in the process of manufacture.

The lamp consists of a glass bulb with a platinum disc forming the base, the glass being brought around the edges of the disc and fused there. By means of this arrangement, the platinum portion may be used over and over again without change. In the accompanying illustrations, Fig. 1, is a side view part sectional of the lamp containing the metal base portion of the bulb. Fig. 2 is a bottom view of the bulb with wires attached. Fig. 3 is a horizontal section, looking downward. Fig. 4 is a side view of the bottom plate and the charging tube on which it is fixed, and the filament. Fig. 5 is a plan view with the filament removed. Fig. 6 is a plan view of the base plate punched out ready for use. Fig 7 is a side elevation of the device shown in Fig. 4. Fig. 8 is a view of the lamp bulb completed with the exterior wires removed.

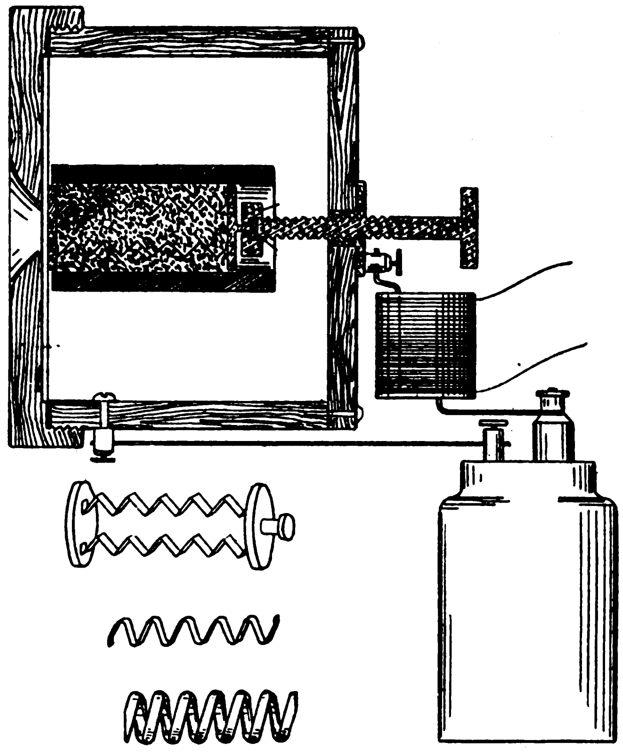


Figs. 1 to 8.—The von der Kammer Incandescent Lamp.

As will be seen the base plate has two upwardly projecting arms, stamped out with it and separated afterward, to which the filament is attached. The details are clearly shown in the illustrations and require no further description. By introducing a bottom of platinum the inventor believes he does not infringe the claim of the Edison lamp patent which covers an "all glass" receiver with leading-in wires.

THE BLOOMER TELEPHONE TRANSMITTER.

A telephone transmitter in which the variable resistance consists of ribbons of carbon plaited or wound together and embedded in a mass of pulverized carbon, has been devised by Mr. Charles T. Bloomer, of this city, and is shown in the accompanying illustrations.



Figs. 1 to 4.—The Bloomer Telephone Transmitter.

Fig. 1 is a cross section of the transmitter showing the resistance, and Figs. 2, 3 and 4 are various forms of the carbon strips. As will be seen, the diaphragm carries at its centre a knob fitting into on elastic tube containing powdered carbon surrounding the resistance strips. The latter are attached at one end to the knob on the diaphragm and at the other to a plate against which presses the adjusting screw. The motions of the resistance strips, imparted by the diaphragm, affect, therefore not only their own resistance but also that of the pulverized carbon mass, and a variation of resistance of the whole conductor is thus set up.

A TELEPHONIC "TICKER" SERVICE.

Buda-Pesth, Austro-Hungary, enjoys the honor of publishing the first telephonic newspaper. Subscribers receive the news of the day in the form of a verbal summary by telephone sent daily between 8 o'clock in the morning and 9 o'clock in the evening. The matter sent out includes political, sporting, local, financial, foreign, etc., as fast as it is received by the editorial office, and the modest charge for the service is about 75 cents a month. There has been some talk of introducing such a system in America. It would of course come in competition with the ticker system, but would be much cheaper.

EXPERIMENTS WITH HIGH FREQUENCY ELECTRIC DISCHARGES.

BY

A. A. C. Swinton

I HAVE read with much interest Mr. Tesla's remarks in THE ELECTRICAL ENGINEER of February 1, referring to my paper on experiments with high-frequency electric discharges published in your issue of January 25. Will Mr. Tesla give a reference to his published description of his method for converting continuous currents into alternating currents of any frequency without the employment of any moving parts? Electricians have, I think, generally understood that in his lectures in this country at the Royal Institution, Mr. Tesla employed throughout an alternating current produced by an alternator. Prof. Elihu Thomson recently mentioned in the London *Electrical Review* as something novel, that he has discovered a means of converting continuous currents into alternating currents of any frequency, but went on to say that owing to exigencies of the patent law he was not in a position to publish the details of his arrangement at present. Mr. James Swinburne has also some years ago suggested a method of arriving at this much-to-be-desired result, but has not, I believe, so far carried his suggestion into practice. I think, therefore, that Mr. Tesla's arrangement cannot be so well known as he appears to imagine.

I should, however, like to point out that the sharply defined pulsatory currents produced by the ordinary arrangement of induction coil with vibrating contact-breaker and condenser, such as I used in my experiments, have in some respects advantages over the more gradually rising and falling alternating currents from an alternator. In certain cases the former give finer effects with a less initial expenditure of power than do the latter.

As regards the physiological effects of high-frequency currents, Mr. Tesla says that he has never considered the current's *strength*, but has only taken into account the *energy* which the human body is capable of receiving without injury. It has, however, I believe, for long been generally recognized that the *energy* is not of any physiological importance, but that it is precisely the *strength* of the current that determines its physiological effect.

I have nowhere stated that the sparking between the two hands of the operator is due to the impedance of his body; in fact, I have mentioned that capacity has apparently something to do with the results obtained. On the other hand, I may mention the following as being scarcely in accordance with what one would expect, according to Mr. Tesla's view. As mentioned in my paper, when one operator puts himself in circuit between one terminal of the high-frequency coil and earth, he can obtain quarter-inch sparks between his two hands. I find that if a second operator takes hold of the hands of the first operator so as to place the bodies of the two operators in parallel, the sparks are reduced to one-eighth of an inch in length, whereas, if the two operators connect themselves in series the sparks are increased in length to one-half inch. It is difficult to see how these results accord with the effects being due entirely to capacity.

As to the heating of the lamp filament in my experiments, I cannot agree with Mr. Tesla, that this is due to bombardment by the molecules of the residual air in the bulb, which is, I take it, his view. If this explanation were correct, the amount of bombardment would be greatest and the incandescence produced consequently at a maximum, when the filament was only connected to one terminal of the coil. As a matter of fact, however, the filament will not incandesce at all under these conditions, though the bulb becomes filled with bluish light. The filament must be put in circuit either between the two coil terminals or between one terminal and a body of considerable capacity before incandescence takes place. In other words, in order that incandescence should occur, a circuit of some description must be provided that will allow a *current* to pass through the filament. Further, in order to produce incandescence it is not necessary that there should be any exhausted bulb at all. The filament will, I find, incandesce in air at the ordinary atmospheric pressure, though, of course, owing to the increased conduction and convection it will not then incandesce so brightly as when in rarefied air. The incandescence is thus clearly attributable to currents flowing backwards and forwards through the filament, and not, to any considerable extent at all events, to the presence of rarefied air in the bulb. If there were no air at all it would incandesce still more brightly.

THE MESTON ALTERNATING MOTOR.

BY

A. H. Meston.

IN a late issue of THE ELECTRICAL ENGINEER[1] there appeared an interesting description of a motor for single phase alternating currents, by Mr. C. E. L. Brown. It was of more than usual interest to the writer as being an almost exact account of a series of experiments carried on by him for some time past, in this new and fascinating field of electrical discovery. It is not with any intention of belittling Mr. Brown's discoveries, or of claiming precedence over them, that this statement is made, but more with a sincere feeling of gratification, to find that one so intimately connected with advance work in this direction, is travelling the same path.

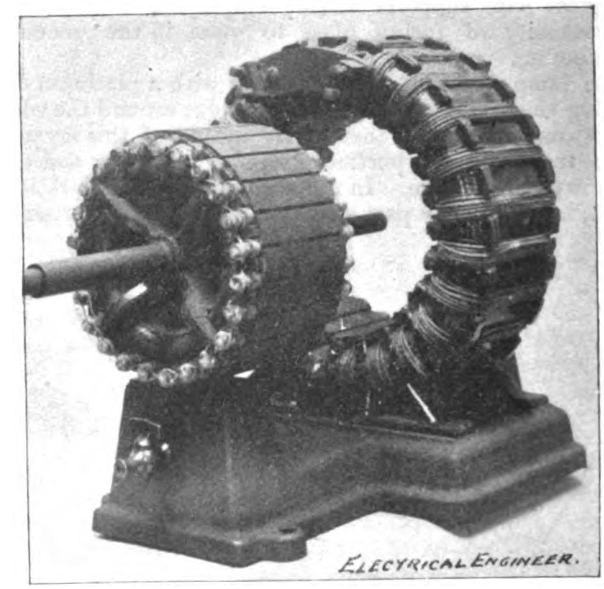


FIG. 1.—MESTON SINGLE PHASE ALTERNATING MOTOR.

The cuts here published show several forms of the apparatus used, made from photographs of the originals. Fig. 1, is a motor with embedded field windings and short-circuited armature bars. Fig. 2, is a starting motor with similar field winding and a special form of armature with commutator. This is utilized in starting and bringing to speed the motor shown in Fig. 1. The two forms have not as yet been combined, as suggested by Mr. Brown.

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[1] See issue of Feb. 8, 1893.

Notwithstanding the evident identity in these forms of apparatus with those operated by Mr. Brown, the writer has heretofore been unable to obtain results as satisfactory as those described by him, which is no doubt due to the fact that the frequencies used have been higher. In this article Mr. Brown does not state what frequencies he employed, so that no comparison can well be made. From lack of time the writer has been unable to push his investigations in this direction, but he hopes soon to be able to publish an account of his experiments with their definite results.

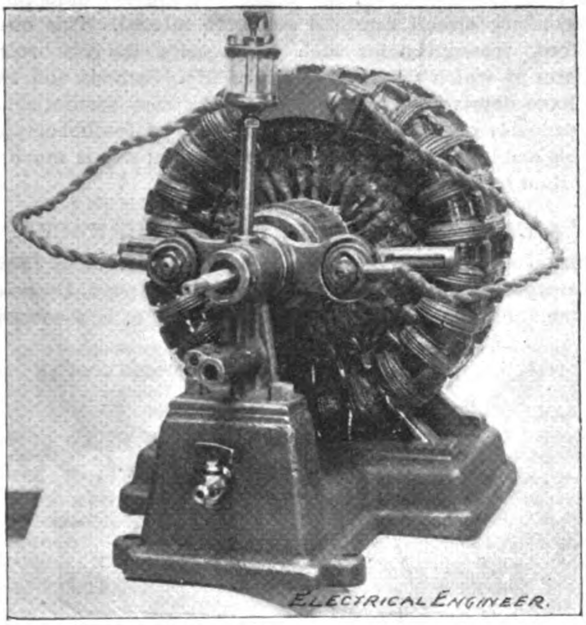
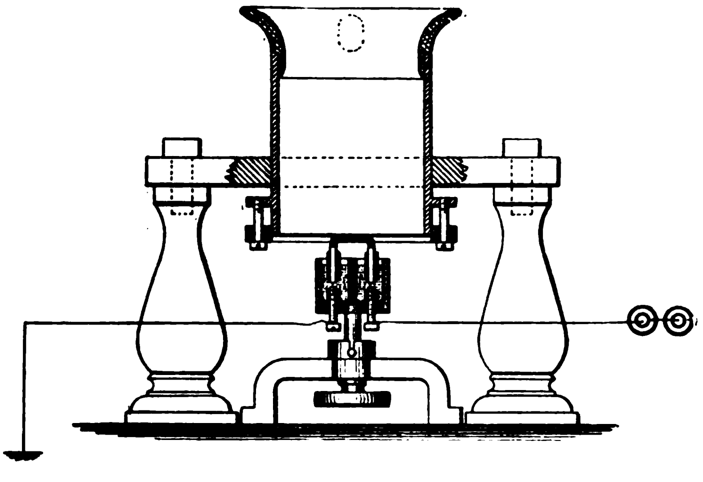


Fig. 2.—Meston Alternating Motor.

THE EDISON ELECTROLYTIC TELEPHONE TRANSMITTER.

The accompanying illustration shows a telephone transmitter, the patent for which has just been granted to Mr. Edison, application having been made in 1877. It consists, as will be readily seen, of a diaphragm connected with electrodes in an electrolytic fluid, so that the vibrations of the diaphragm cause the electrodes to approach and recede from each other, and thus vary the resistance in the circuit.



Edison Electrolytic Telephone Transmitter.

THE NEW GRAY TELAUTOGRAPH.

From the earliest attempts at conveying intelligence through the medium of electricity the method of fac-simile reproduction has been the beau ideal of the telegrapher. The chemical telegraph of Bain was one of the first of this type which has been succeeded by others of the same nature; but more recently inventors have turned to electro-mechanical devices for the carrying out of this method of transmission in order to avoid the inevitable accompaniments of a chemical telegraph.

We have already made mention on various occasions of the fac-simile telegraph apparatus devised by Prof. Elisha Gray of Chicago, and known as the "telautograph." As constructed a year or more ago the apparatus involved the movement of a pen placed at the intersection of two arms, the motion of which was controlled by a pair of electro-magnets, acting differentially on armatures connected to the arms carrying the pen. The action of the magnets was controlled from the other end of the line by varying the resistance in the circuit of each, the variation being effected by the motion of the stylus in the hands of the person transmitting. Since that time Prof. Gray has embodied a number of new principles in the construction of both the receiver and the transmitter by which the character of the work has been greatly improved, and a set of this apparatus is now in operation in this city.

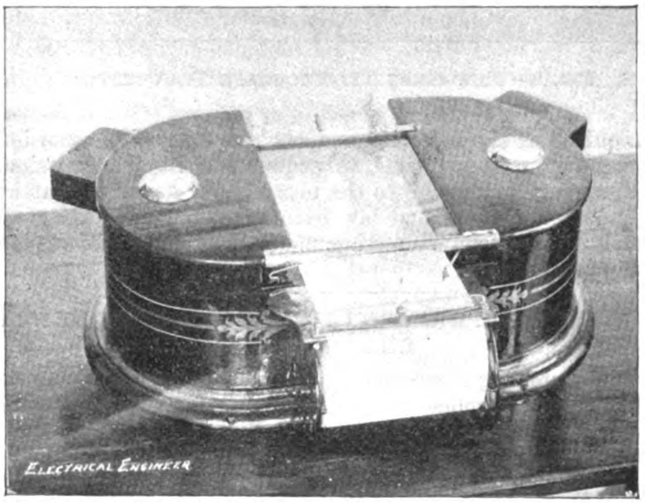


Fig. 1.—New Gray Telautograph Receiver.

The accompanying engravings, Figs. 1 and 2, show the receiver and transmitter. The person transmitting writes the message on a continuous roll of paper by means of a stylus carrying a lead point and ball joint which is attached to two silk cords which transmit the motion to the mechanism within.

At the receiving end a fine glass tube fed with ink reproduces the motion of the stylus at the transmitting end, the record being left upon a similar continuous roll of paper, which can be preserved for reference. The lever shown at the left of the transmitter is so moved by hand as to shift the paper forward mechanically at the transmitter and electrically at the receiver.

One of the great advantages of the present system is that it requires no special method of writing, so that any one who is able to write can operate the instrument. Specimens of work which we have seen and which we have ourselves made with the telautograph leave little room for doubt as to the thorough practicability of this system of transmission.

At the offices of the Gray National Telautograph Company, in this city there are in operation a number of these instruments illustrating the manner in which they can be applied to exchange work in cities as a substitute for the telephone. The arrangements are such that no attendant is required at the receiving end, the message being recorded for inspection at any time subsequent to its transmission. We regret that owing to the necessity of guarding patent rights, we are unable to lay before our readers the full details of the very interesting mechanism employed in the new telautograph.

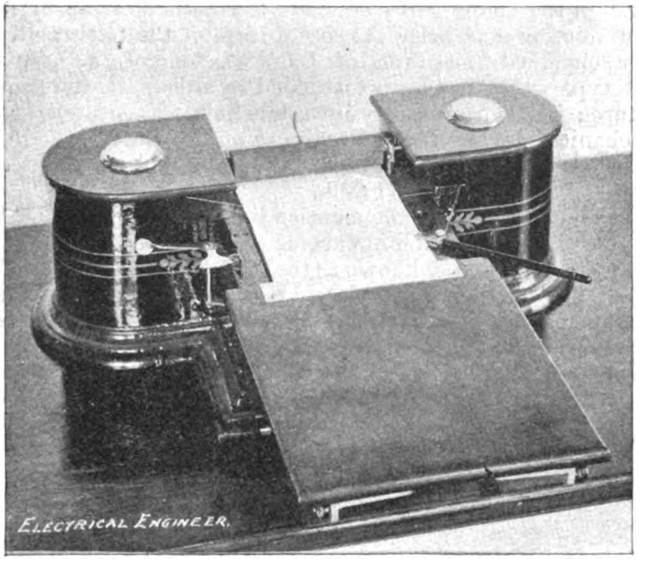
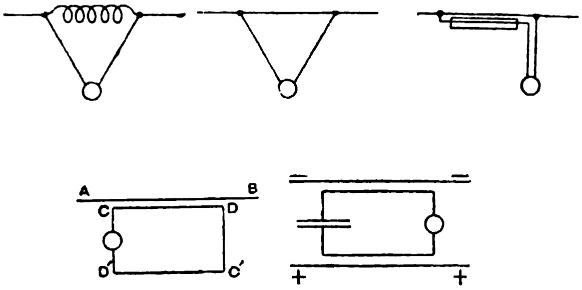


FIG. 2.—NEW GRAY TELAUTOGRAPH TRANSMITTER.

M. JANET'S EXPERIMENTS WITH HIGH-FREQUENCY CURRENTS.[1]

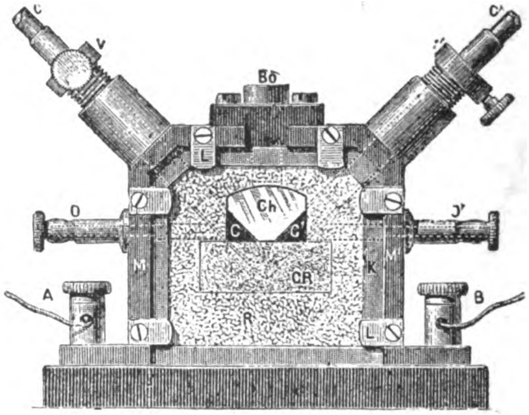
THE interesting experiment of Elihu Thomson which consists in lighting an incandescent lamp by shunting it with a few turns of copper (Fig. 1) traversed by a high-frequency current, is well known.[2] At the exhibition of the Société de Physique, M. Janet repeated this experiment with success, but replaced the spiral by a simple rod of copper (Fig. 2). The phenomenon appeared explicable, as in the case of Elihu Thomson's experiment, either by the self-induction of the rod, or by an actual increase in its resistance. M. Janet has, however, recently shown in a simple manner that the effect should be attributed to mutual induction. He brought one of the wires of the lamp circuit parallel to the principal circuit, as shown in Fig. 3, insulating it by a glass tube; the lamp went out immediately. If a rectangle C D C′ D′ is brought up to the rod A B, a lamp in the circuit C D C′ D′ lights up (Fig. 4). If the circuits are arranged as in (Fig. 5) and a condenser is introduced into the circuit C D C′ D′, the lamp brightens up if the conditions are suitable. In fact, if we have a variable inductance in the circuit C D C′ D′, the capacity being fixed and the inferior to a certain value, the brilliancy of the lamp attains a clearly marked maximum for a certain value of self-induction. This maximum occurs when the period of the secondary circuit is equal to that of the primary current. On the other hand, if the capacity of the primary circuit is altered, it is found that in order to obtain the maximum brilliancy either the capacity or the self-induction of the secondary circuit must be similarly altered. This circuit, therefore, reassumes for such frequencies its true *role* of resonator of which the experiments of MM. Sarassin and De la Rive have deprived it in the case of Hertzian oscillations. It may probably be concluded that in the case of frequencies such as those employed by Elihu Thomson damping out is much less rapid than for Hertzian oscillations.



FIGS. 1 TO 5.—HIGH FREQUENCY EXPERIMENTS.

A LABORATORY ELECTRICAL FURNACE.

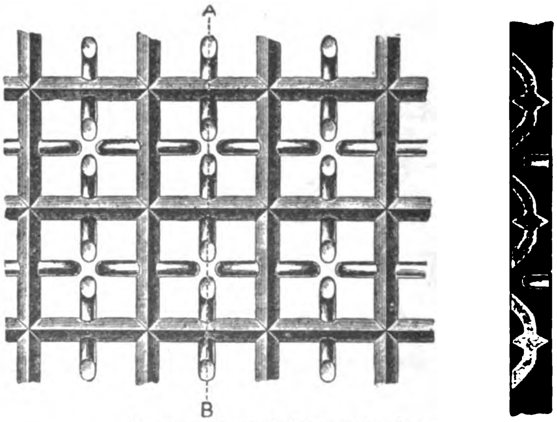
THE accompanying illustration shows a convenient form of laboratory furnace designed and made by Messrs. Ducretet & Lejeune, of Paris. The block of fireclay, C R, is the crucible, which can be taken out at will. The carbons, C C^1, can be moved by the screws, vv^1, or, by being pushed out after slackening the set screws. O O^1 are the terminals. The experiments can he watched, as the ends are covered in by mica, held by the clasp L fastened to the metal framework M M^1. This furnace will work with a current of 12 volts and 12 amperes. According to the *Génie Civil*, from whose columns the particulars and illustration were taken the furnace works admirably.



A LABORATORY ELECTRICAL FURNACE.

THE "CLAW" BATTERY GRID.[1]

THE accompanying illustration show the latest type of secondary battery grid, introduced by the Electrical Power Storage Co., of 4 Great Winchester street, London, E. C. It is chiefly used for negative plates, but in many cases it is employed for the positive also. This construction is intended to hold the pieces of active material more securely, but at the same time to allow scope for the expansion on discharging without causing little blocks to fall out. The conducting surface is also largely increased.



THE "CLAW" BATTERY GRID.

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[1] La Lumière Electrique.

[2] The author appears to be in error here. This experiment was first alluded to and shown by Mr. Nikola Tesla in his lecture before the American Institute of Electrical Engineers, at Columbia College, on May 20, 1891.—EDS. E. E.

[1] *Industries.*

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Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
Western Editor and Manager, L. W. COLLINS. 575 The Rookery, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. HANKS.
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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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VOL. XV. NEW YORK, MARCH 22, 1893 No. 255.

RECENT IMPROVEMENTS IN TRANSFORMERS.

THE progress which has been made during the last few years in alternating current work finds no better illustration than the demonstrated improvement which has been effected in the efficiency of the transformer itself. It is not so very long ago that the leading electrical engineering societies at home and abroad devoted much time to the discussion of the relative economies of direct and alternate current distribution; and even at the present time the subject is one of peculiar charm to many engineers.

In these discussions, the opponents of the alternate current system have been wont to lay great stress, and rightly so, we think, upon the low efficiency of transformers at light loads, and were able to show that in many cases the economy gained by reduction in copper was not infrequently counterbalanced by the increased consumption of coal due to the action of the transformers as constructed at that time. But if we judge aright the results of the elaborate series of tests made by Dr. Fleming and communicated to the London Institution of Electrical Engineers, the adherents of the direct current system will have to modify their views, in so far at least as they are based on the older designs of transformers. In the paper above referred to, Dr. Fleming shows in effect that the principal types of modern transformers including the Westinghouse, Mordey-Brush, Ferranti, Thomson-Houston, Kapp and Swinburne have an efficiency equal, if not superior, to that of the dynamo itself. Thus at full load the efficiencies of the various types above enumerated varied between 93.5 and 96.9 per cent.; at half load from 91.2 to 96.1 per cent.; at one-tenth load from 71.7 to 88.1 per cent.; while even at one-twentieth of full load the least economical of the transformers indicated 56.2 per cent. efficiency. It must be admitted that the results here obtained must materially modify the calculations as to the relative economy of the direct and alternating systems. But Dr. Fleming's tests have served to bring out another point, namely, the superiority of the closed magnetic circuit type of transformer over that of the open circuit. Mr. James Swinburne, the champion of the latter has for some time contended that the open circuit type was superior to the closed circuit, more particularly at light loads, that is, at the normal working condition of transformers.

The tests, however, do not bear out these claims, for by comparing a Swinburne 6 kilowatt with a Westinghouse 6½ kilowatt transformer, we get the following efficiencies:

		Load.				
		$\frac{1}{40}$	$\frac{1}{20}$	$\frac{1}{10}$	$\frac{1}{2}$	Full Load.
Westinghouse 6½ K. W.	Per cent.	61.8	75.9	85.7	96.	96.9
Swinburne 6 K. W.		48.4	65.2	79.	94.8	96.1

The superiority of the closed circuit type especially at light loads is here so apparent that the benefit claimed by Mr. Swinburne can now be justified only on the assumption that his comparisons were made with other transformers of older types, some of which were also tested by Dr. Fleming and shown to be very inefficient at light loads. The tests showed that with open magnetic circuit transformers, on open secondary, the leakage current was far greater than in the case of the closed circuit type, and hence involved corresponding line losses, and a larger number of generators to maintain proper potential on the lines at periods of light load. It was also demonstrated by Dr. Fleming that a wattmeter is the best instrument for measuring power, and that the iron losses are constant for all loads, so that the efficiency of a transformer can be found by taking the no load loss and adding the $C^2 R$ loss to get the loss at any other load.

The results here obtained will go far towards settling many doubts in the minds of constructors, and we are glad to note that a prominent American transformer showed up as efficiently as, if not a trifle superior to, the best foreign types of equal capacity.

"Incandescent" Arc Lighting.

WHAT for want of a better name has been termed "incandescent arc lighting," is fast coming into prominence, and if we are not mistaken it will have an important influence on the trend of the lighting industry in the future. The higher efficiency in candle power per watt expended in the arc as compared with the incandescent lamp is too well known to require further comment at this late day, but the actual conditions as involving the cost of lighting a given space by the two methods have probably not been brought home to many users of the electric light. This side of the question is taken up by Mr. Augustus Noll, who shows in an admirable article elsewhere in this issue, the economy involved in the use of the arc. Aside from this aspect of the question it would not seem improbable that the present strain in the incandescent lamp situation may be removed by the more general use of the arc lamp run from incandescent circuits.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC TRACTION IN THE CITY OF PHILADELPHIA.

BY

R. L. Warner

I.—THE CITY *vs.* THE TROLLEY.

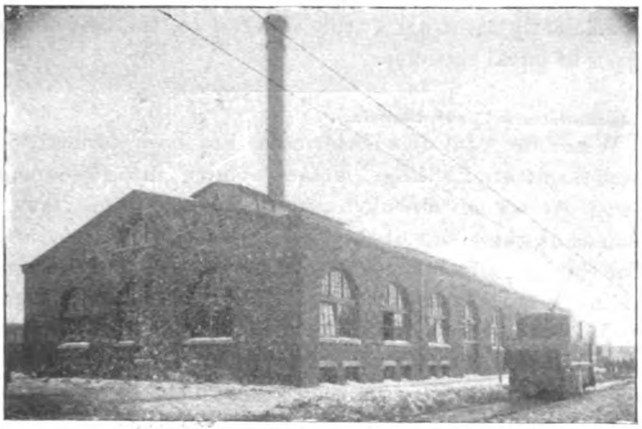
WHEN the Philadelphia Traction Company early last spring proposed to begin the work of transformation from animal to electric traction upon certain of the city lines under its control, it was met by the most determined opposition on the part of a citizens' organization assisted by a portion of the public press, and injunction after injunction was secured to delay the prospected improvement. The efforts of the obstructionists prevailed to keep the matter in the courts for some months and the time-honored horse-car continued meanwhile to afford the Quaker City rapid transit.

One line, however, that on Catharine and Bainbridge streets, was exempted from legal process owing to a peculiarity of its charter providing that any means of traction might be employed. Work was therefore commenced upon this line during the month of August and was pushed so vigorously that on the 15th day of December Philadelphia's first trolley cars commenced running an a regular schedule upon the streets mentioned.

The operation of the road has been most successful from the very start, not a single breakdown or accident of any kind having occurred even during the heavy snows of early January, and, as usual, many of the most radical opponents of the trolley system before its adoption have since become its firmest friends.

On January 3 the Supreme Court of Pennsylvania rendered a decision in the trolley cases, as published in THE ENGINEER, authorizing the Philadelphia Traction Company to proceed with the construction of trolley lines according to the act of councils of March 31, 1892, the ultimate effect of which will be to substitute trolley-cars for the horse-cars now used on most of the city lines. The importance of this decision to the interests of electric traction is very considerable, opening as it does another of the principal cities of the country to the use of the trolley, and involving power stations and equipment for over one thousand electric cars.

Active preparations are being made for proceeding with the work of construction and the Traction Company expects to have trolley cars running over six or seven of its lines by the early part of the summer. The streets first to undergo the change will be those which can be most conveniently operated from the present power station; the extension of the Catharine and Bainbridge streets line along the Gray's Ferry road; the Morris and Tasker streets line; Christian and Ellsworth; and Spruce and Pine streets.

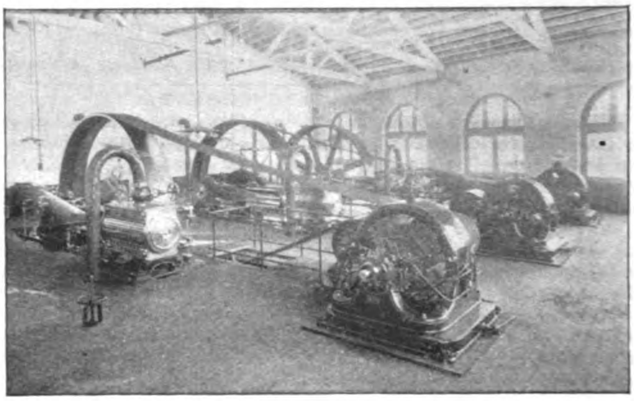


FIRST RAILWAY POWER STATION AND CAR SHED, PHILADELPHIA, PA.

In view of the importance of the Catharine and Bainbridge streets line as the first trolley road in Philadelphia, a description of the characteristic features of its construction may be of interest.

II.—LINE AND TRACK CONSTRUCTION.

The track and overhead work as well as the general arrangement and equipment of the power station were carried out under the direction of the Field Engineering Co. of New York. The track, which is $5\frac{1}{20}$ miles in length, is built of 90 pound steel rails $9\frac{1}{2}$ inches high, laid on 6 inch sawed ties, and set to gauge, which is 5 feet $2\frac{1}{2}$ inches, with tie rods 3 feet apart. The rails are joined by heavy fish plates, six $\frac{3}{4}$ inch bolts being used in each rail.



GENERATOR PLANT OF THE PHILADELPHIA TRACTION COMPANY.

For bonding, No. 0 galvanized iron wire is used. Two holes are bored in the web near the end of each rail and the wires are looped through these holes and fastened by means of channel pins driven tight, thus making a triple bond of No. 0 iron at each rail joint.

The rails are cross-connected every 90 feet, no continuous wire being used. This construction gives a resistance for the return circuit of about .045 ohms per mile of single track.

A line of cobble stones is set against each rail and the space between the rails is filled in with concrete, the remainder of the street being paved with asphalt.

The feeder conduit is built up of $\frac{1}{16}$ inch wrought iron pipe lined with $\frac{5}{8}$ of an inch of cement, and has an internal diameter of $3\frac{1}{4}$ inches. In this conduit are laid two No. 0000 feeder mains of Standard Underground cable, and a small line for use in testing.

Sixteen feeder taps of No. 0 wire connect the mains with the trolley wire, and to each of these taps is connected a special Westinghouse line lightning arrester.

The conduit manholes are from 200 to 400 feet apart, and in each one the signal line passes through a pair of terminals provided for the attachment of a portable telephone by means of which communication may be established between any two manholes or with the testing room at the power station.

The poles which are of 4, 5, and 6 inch wrought iron, are 28 feet in length and weigh about 700 pounds each. They are placed $5\frac{1}{2}$ feet in the earth, 125 feet apart, set in concrete and tamped with a rake of from 4 to 12 inches, depending upon the character of the soil. The span wire is No. 8, the guard wire No. 6, and both are of silicon bronze, this being a requirement of the city electrician. The guard wires are placed 3 feet apart and are 18 inches above the trolley wire. The latter is of No. 0 hard drawn copper, divided into four sections of from 1 to $1\frac{1}{2}$ miles in length. The line work is most carefully insulated at every point and presents a very neat appearance.

III.—POWER STATION AND CAR SHED.

The power station and car shed combined is located on the corner of Southerland Ave. and Kansas St. The building is of brick with a wooden truss tar and gravel roof, and was designed with a view to enlargement whenever the increased demand for power should require it. The boiler-room floor is on a level with the street, the floor of the engine room being five feet higher. The engine and boiler-rooms are separated by a brick wall having fire-proof doors, and against this wall, seven feet above the boiler-room floor, is built the main smoke flue which runs across the building back of the row of boilers to the stack.

The stack is of iron 105 feet in height set upon a 30-foot brick foundation, making a total height above the street of 135 feet. The foundations are of brick laid upon two feet of concrete. The engine bed-plates rest directly upon the brick; the idler foundations are capped with stone.

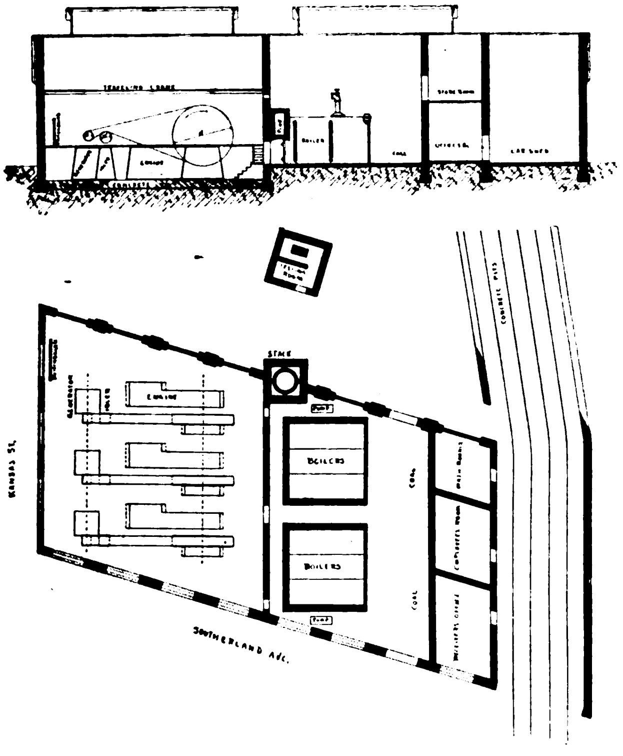
The foundations for the generators are surmounted by a base one foot in thickness, built up by layers of two-inch pine planking insulated with tarred paper and asbestos. A traveling crane is being built for the engine room to facilitate repairs or inspection of machinery.

West of the boiler room and opening on the entrance to the car shed are the offices of the company's receiver and rooms for motormen and conductors. The car shed is 28 feet wide by 320 feet long and will accommodate 24 cars. Concrete pits five feet deep extend nearly the entire length of the shed, which is well adapted to the inspection and cleaning of cars and motors.

In addition to the main building an isolated testing room with brick walls has been built south of the boiler room with foundations for instruments, etc., and the equipment of a machine shop for making minor repairs is contemplated.

IV.—THE STEAM PLANT.

The steam plant at present consists of six horizontal return tubular boilers 72 inches in diameter by 20 feet long, and three single cylinder Corliss engines 22 inches in diameter by 48 inches stroke, both engines and boilers being furnished by Messrs. Robt. Wetherill & Co., of Philadelphia. The boilers are arranged in two batteries of three boilers each and the steam-piping is so designed that any engine can be run with any boiler. Each boiler contains 56 steel tubes 4¼ inches in diameter and works under a steam pressure of 100 pounds.



Plan and Section of Power Plant.

The engines are designed to develop 250 h. p. each at 80 revolutions per minute when working non-condensing. The fly-wheels are 18 feet in diameter by 34 inches face. The steam is carried from each boiler by 7 inch piping to a 12 inch main back of the engine foundations, from which 7 inch pipes rise to the engines. All piping and joints have a covering of Brown's porous cement three inches in thickness in place of the usual asbestos. Water is supplied to the boilers by the Snow duplex pumps 8 x 6 x 10 inches and monitor injectors. The exhaust steam is used for feed water heating, by means of a Wetherill vertical heater 46 inches in diameter by 10 feet high, containing 127 two inch brass tubes. The steam passes into the atmosphere through a Lyman exhaust head.

The necessity of obtaining water from the city mains has thus far precluded the use of condensers. The plans for the contemplated enlargement of the station however, include the laying of a pipe line and the installation of pumps to procure water for all purposes from the Schuylkill river. An emergency tank of 60,000 gallons capacity has been erected south of the boiler room for use in case of temporary failure of the city mains.

V.—ELECTRICAL EQUIPMENT.

Three 250 h. p. Westinghouse four-pole generators running at 535 revolutions per minute comprise the electrical generating equipment of the station. The generators are independently belted direct to the fly-wheels of the engines by four-ply cotton-leather belts 32 inches wide. The distance between centres is 35 feet. In order to prevent slapping and swinging of the belts under sudden changes of load as well as to increase the arc of contact of the belts with the generator pulleys, 36-inch stationary idlers are set beneath the belts near the generators. The belts are therefore run with the light side on top, the slack of the belt thus falling upon the idler.

This somewhat unusual arrangement has proven quite satisfactory in this case, the belts running very steadily even under excessive changes of load.

The switchboard is of the skeleton type, all instruments being separately mounted upon white-marble bases. From the brushes of each machine the main leads pass inside the frame through an opening in the foundation, thence under the engine-room floor, to the main switches connecting with the bus bars. An automatic circuit breaker and an ammeter are placed in circuit with each machine and a 1,500-ampere ammeter is used to show the total current output of the station. The four feeder mains have also each a separate ammeter and circuit breaker and the station is protected from injury by lightning by a "Keystone" arrester connected with each feeder. In order to call the attention of the engineer in charge to the opening of a circuit breaker, there is mounted upon the switchboard an alarm bell which commences ringing upon the opening of any one of the breakers and only ceases when all are again closed. From the bus bars the feeder mains pass to a vault beneath the engine-room floor and thence to the street conduits.

The testing room is provided with a Thomson galvanometer and silver chloride battery for testing the insulation of the feeders, which has been maintained at over 1,000 megohms per mile.

There are at present 20 cars in operation on the line, running on a three minute schedule. They are each equipped with two 20 h. p. Westinghouse single reduction motors operated by the E type series multiple controllers. The advantage of the series multiple method of operation is especially manifest on this line since the cars must be run over considerable portions of its length at comparatively slow speeds.

It is a fact worthy of note that the receipts from this road have increased over 50 per cent. since the change from animal to electric traction, and the general sentiment is that the much-abused trolley is after all a public convenience fast becoming a necessity.

PROPOSED LEGISLATION IN CONNECTICUT ON ELECTRIC ROADS.

The committee on cities and boroughs of the Connecticut Legislature gave up a long session last week to the consideration of two acts relating to street railroads, together with the rights, powers and duties of such companies and the towns through which they run. The attendance was so large that an adjournment to the House was found to be necessary.

The Hon. Henry C. Robinson appeared before the committee in support of a measure to restrict the proposed electric roads. Mr. Robinson made no attempt to conceal the authorship of the bill. He and President Clark of the Consolidated Road had drawn it up, for the most part, but there were portions of it which neither approved. These he would rectify later by a substitute measure.

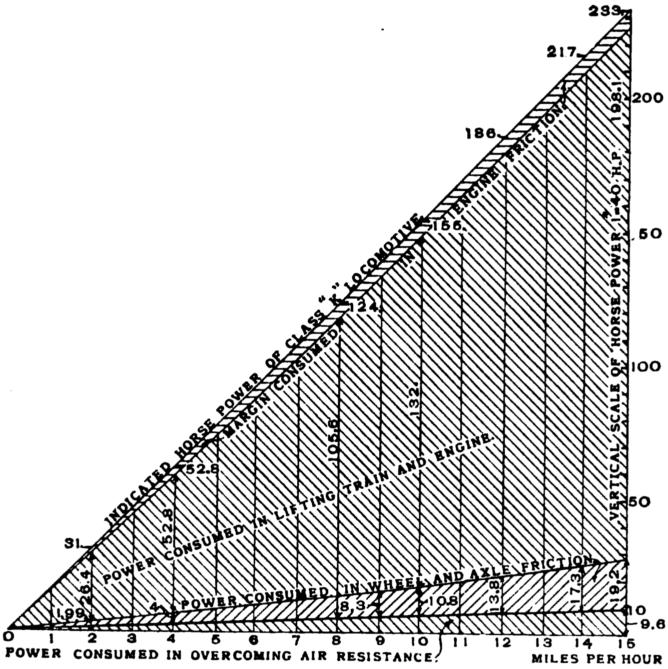
The bill as it stands makes it obligatory that $3,000 shall be subscribed for every approved mile of road by reliable parties; that the consent of one-half of the property owners along the highway outside of a city or town shall be procured; that the issue of bonds shall be limited to one-half the cost of construction; that the approval of the State Board of Railroad Commissioners must be had for lines constructed outside of towns and cities, said board to also have jurisdiction over such roads and power to determine limitations of speed; that the speed shall not exceed six miles an hour in cities and 10 miles an hour outside cities; and that no electric road shall transport baggage aside from ordinary hand parcels or merchandise.

George E. Terry, attorney for the Waterbury street railroad, made a strong argument in favor of the bill introduced by Senator Root, establishing a board of electrical control to consist of one electrician, one business man and one lawyer. Mr. Terry prepared this bill himself and thought it covered the ground better than anything else proposed so far. He thought it would prevent the friction sure to result in case of local control where a road ran through several towns. He criticised Mr. Robinson's bill and was especially severe upon the bond clause. The only way such roads can be built is by a sale of bonds. The question at issue is whether the roads shall be controlled by the Railroad Commissioners, as proposed by Mr. Robinson, or by a special electrical commission or by local option.

HORSE POWER REQUIRED ON THE NEW YORK ELEVATED RAILWAYS.

As the near future will probably see definite attempts made to introduce electric locomotives on the New York elevated railway, it is of interest and value to electric railway engineers to know the exact work required of the locomotives.

The annexed diagram from the *Railroad Gazette*, shows the increase of horse power required at different speeds with a standard Manhattan elevated locomotive drawing a regular five-car train loaded with passengers up a two per cent. grade, as determined by the Manhattan Railroad Co. from their records. The following are the data on which the diagram is based :



HORSE POWER REQUIRED ON THE NEW YORK ELEVATED RAILWAYS.

Class "K" engines, cylinders 12 inches x 16 inches ; drivers 42 inches ; total weight, 24 tons ; mean effective cylinder pressure, 100 lbs. per square inch ; gross tractive power about 5,500 lbs.; train weight, five loaded coaches = 100 tons ; grade, 105.6 feet per mile ; atmospheric resistance, with head wind of 10 miles per hour at speed of 15 miles per hour = three lbs. per square foot on 80 square feet. Wheel and axle friction figured by Burlington brake test formula $\frac{3.5 + V^2}{673}$.

ELECTRIC RAILROADING BETWEEN BROCKTON AND BOSTON.

WITHIN the past fortnight several Boston and Brockton capitalists have been planning for a system of street railways which will connect many small towns with Brockton, connecting them at that point with a line to Boston. At a meeting just held in Boston the following companies were organized :

Brockton and East Bridgewater, five miles of track. Directors, Aaron Hobart, R. O. Harris, East Bridgewater; Alfred A. Glasier, Allston Burr, George H. Campbell, Boston; H. B. Rogers, John P. Morse, Brockton. Capital, $100,000.

East Bridgewater and Bridgewater, three miles of track. Directors, James C. Leach, Hosea Kingman, Bridgewater; Aaron Hobart, Robert O. Harris, East Bridgewater; Glasier and Campbell, Boston; Rogers of Brockton. Capital, $100,000.

Brockton and Bridgewater, six miles of track. Directors, Kingman and Leach, Bridgewater; Glasier, Campbell and Burr, Boston; Morse and Rogers, Brockton. Capital, $200,000.

Brockton and Stoughton, five miles of track. Directors, Charles Tenney, George F. Walker, Stoughton; Glasier, Campbell and Burr, of Boston; Morse and Rogers, of Brockton.

MR. EDISON is said to be doing quite a business in the sale of sand obtained as a by-product at his Ogden, N. J., iron mine. This sand, being sharper, heavier and dryer than any sedimentary sand, is in great demand for the sand boxes of locomotives and electric cars.

PROPOSED STREET RAILWAY LEGISLATION IN NEW YORK.

Senator McCarty, of the New York Legislature, has introduced a bill providing that in cities of more than 800,000 inhabitants street surface railroads shall pay an annual tax as follows to the city : 1 per cent. when gross receipts are $20,000 a mile ; 2 per cent. when gross receipts are from $20,000 to $40,000 a mile, and 3 per cent. when gross receipts are more than $40,000 a mile.

It is understood that Senator McCarty will present a measure proposing a tax of 5 per cent. on the gross receipts of every corporation that uses the streets of Brooklyn, which includes elevated and horse railways, telegraph, telephone and electric lighting companies.

In the Assembly Mr. Quigley has introduced a bill applying the law for 10 hours' labor on street railroads to cities of 75,000 inhabitants and over, and forbidding railroad companies from accepting more than 10 hours' daily labor from employés.

RAILWAY CONDITIONS AT CEDAR RAPIDS, IA.

MR. ROYAL H. HOLBROOK, of the Cedar Rapids & Marion City Railway Company, writes us as to the operation of the electric roads in northerly latitudes during the present severe winter:—We have had but little trouble by snow. In fact, our city lines have never stopped since we started in November, 1891. We have one very bad place on our suburban line to Marion, the county seat, six miles distant, which gave us a little trouble in the big storm of February 6, when nearly all the steam railroads of the West were tied up for a whole day.

MISCELLANEOUS.

NEW KELVIN ENGINE-ROOM WATTMETER.[1]

THE latest invention of Lord Kelvin is an engine-room wattmeter. The interior is shown in Fig. 1. It has a main circuit formed of a double rectangle of copper rod having sufficient area to carry 200 amperes, and a shunt circuit with two fine wire coils astatically arranged. The main coil is mounted on a slate back so that the rectangles are horizontal. The shunt coils are mounted on a light but strong aluminum frame in the manner shown in Fig. 2. One end of this frame has a circular knife-edge fixed to it, and the other end has a straight knife-edge. These two knife-edges rest on two phosphor-bronze hooks attached by insulating supports to the outside ends of the double rectangle. By this method of suspension complete freedom from friction is obtained, while the movable system is kept in a definite position without end guides.

Each fine wire coil has about 1,000 turns of insulated wire, and its resistance is about 100 ohms. The current is conducted in and out from the movable system by two flat palladium spiral springs which also supply the restoring force for governing the sensibility of the instrument. Not more than $\frac{1}{20}$th of an ampere is allowed to pass through the fine wire circuit, and in order to regulate this, a large non-inductive resistance is rolled on the case of the instrument which offers a large cooling surface. The scale has nearly uniform divisions, and is graduated to read directly in watts or kilowatts as required. The capacity of this instrument is 200 amperes, the volts being immaterial.

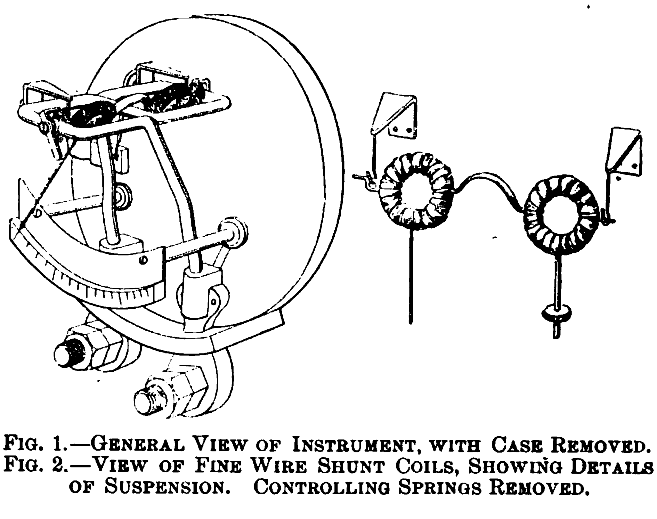


FIG. 1.—GENERAL VIEW OF INSTRUMENT, WITH CASE REMOVED.
FIG. 2.—VIEW OF FINE WIRE SHUNT COILS, SHOWING DETAILS OF SUSPENSION. CONTROLLING SPRINGS REMOVED.

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[1] The London *Electrician*.

SEARCH LIGHT PROJECTORS.—AN EXPERIMENTAL COMPARISON OF THE MANGIN AND SCHUCKERT PROJECTORS.[1]

BY M. BURSTYN.

SCHUCKERT'S projector, with its parabolic glass-mirror, is such an improvement in the branch to which the use of searchlights on board of war-vessels belongs, that it has attracted a great deal of attention in maritime-technical circles, and most maritime governments have made extensive experiments with it.

Until Schuckert invented his parabolic glass mirror, the Mangin projector with its glass-mirror, composed of two spherical surfaces of different radii, was,—and quite properly so—looked upon as the best in existence. Its performance was to such an extent superior to that of all other projectors then known, that nearly all the military powers of the world had adopted it. Concentration of the rays as well as uniformity of the same, and a sharply drawn boundary was reached in a manner never before attained; the uniformity of the light and the sharply drawn boundary were also maintained when the light was dispersed by moving the lamp out of focus.

The defects of this, concededly admirably conceived Mangin mirror, viz., the relatively large focal distance and the great thickness of the glass were willingly accepted in view of the important advantages which the mirror offered and of the eminent practical appliances which Sautter-Lemonnier had given to the whole apparatus. Schuckert's parabolic glass-mirror has, as far as this is at all possible, overcome all these defects and must be regarded as a further improvement in the construction of mirrors for searchlight projectors. Theoretical considerations as well as practical experiments have proved the considerable superiority of the Schuckert projector over the Mangin projector. Below we shall give an account of the results which were obtained in the summer of 1891, at Pola, the central harbor of the imperial Austrian Navy, where experiments and photometrical measurements were made with Schuckert and Mangin projectors. The experiments were carried out with two 60 centimetre projectors, to one of which was fitted a Mangin mirror, and to the other a Schuckert mirror. Before we give the results of the experiments and measurements, the following general remarks may not be out of place:

When not taking into account the absorption of light in the glass and the sending out of diffused light, or when, more correctly speaking, these and other inevitable losses are supposed to be equal with both mirrors, which supposition seems to be justified in itself and by the results shown further on, then the quantity of light sent out from the mirror must be proportional to the quantity of light which falls upon it. Supposing the sources of light are equal, then the quantity of light which reaches the mirror will be a function of the angle of the cone of light falling upon the mirror, if it is further supposed that within this angle the surface-intensity is the same for all rays. It is well known that with arc-lamps this is not strictly the case. The above angle depends on the focal distance and the diameter of the mirror.

With these suppositions the quantity of light reaching the mirror will be in proportion to the area of a segment of a sphere having its centre in the focus, the segment being formed by the cone of light described above, in penetrating the surface of the sphere. From the same point of view the intensifying power of a projector (expressed by the number of times which the surface intensity of the light sent out by the mirror is greater than the one received) will be represented by the ratio of the surfaces of two spherical segments of equal radii, the one being formed by the angle of the cone of light, and the other by the dispersing angle of the mirror.

The focal length of both mirrors experimented with were measured as exactly as possible by means of direct sunlight, and were found to be 42 centimetres for the Mangin mirror and 25 centimetres for the Schuckert mirror. In consideration of the spherical shape of the former and the parabolic curvature of the latter, and by direct measurements, the angle of the cone of light received by the mirror from the arc, here called the useful angle, was found to be 83 degrees for the Mangin, and 124 degrees for the Schuckert mirror, the proportion of the areas of the respective spherical segments being 1 : 2.11. If therefore the same source of light is used in Schuckert's projector and in Mangin's and both mirrors use the light equally well, then the quantity of light sent out by the Schuckert mirror must be 2.11 times the light sent out by the Mangin mirror, when the distribution of the light over the surfaces of the mirrors is the same in both cases.

In applying concentrated light, *i. e.*, with the lamp in the focus, the dispersing angle of the light leaving the mirror has been found to average 2.2 degrees for the Mangin and 3 degrees for the Schuckert projector. In consequence of the above considerations, then, the reflecting power of the Mangin protector will be 1360 against 1770 for Schuckert's projector, the lighted field of the latter being at the same time 1.8 times as large as that of the Mangin projector. Summing up the last two points, the Schuckert projector produces light of 1.8 times greater brightness and 1.8 times larger space than the Mangin projector, when similar sources of light are employed.

After having mentioned that Schuckert in his projector uses a lamp with horizontal carbons, while in the Mangin projector the carbons are inclined 60 degrees to the horizon, we may describe the manner and the results of the photometrical measurements. To ascertain the quantity of light thrown upon the mirror, the lamp was placed at a precisely measured distance in a box, the front partition of which contained ten holes which were placed in a straight line from the centre and could be opened and closed at will. The intensity of the light coming from each of the openings was measured by means of a Weber's photometer and the quantities of light falling upon the mirror were calculated in the following manner:

If the distance from the photometer to the source of light is represented by D, the distance from the mirror to the light, *i. e.*, the focal length, by D_1; if dr is the reading (red) of the photometer at the distance D and dr_1 represents the desired reading at the photometer at the distance D_1 from the focus, then

$$dr_1 = \frac{D_1 \times dr}{D}.$$

The intensity of the light at the distance D_1 is therefore

$$I = k\,C \times \frac{D_1^2,}{dr_1^2}$$

where k is the color co-efficient for the light measured, and C the constant of the photometer-plate used.

If $D_1 = 1$, and σ is the intensity, it follows that

$$\sigma = \frac{k \times C}{dr_1^2},$$

representing the number of candles, which would be necessary at a distance of one centimeter for creating the same brightness on the mirror, which the lamp produces at the distance D_1.

This σ, which may be called "surface-intensity,"[2] bears a certain relation to the number of rays, which meet the unit of area i at the distance D_1; it measures, as it were, the strength of the field of light at this distance. If an area F is lighted with the surface-intensity σ, the quantity of light falling upon this area can be represented by $F\sigma$. It was next assumed that each zone of the mirror be lighted with such a surface-intensity, corresponding to the middle of the two adjoining openings in the box. In this manner, under the foregoing assumptions, the quantity of light, which every zone of the mirror receives from the source of light, has been calculated.

During the measurements with the photometer the strength of the current was kept as far as possible at 64 amperes. The readings of the strength of current were taken exactly at the same time as the measurements with the photometer. Where differences in the strength of current took place, the intensity of light was reduced to 64 amperes, on the assumption that the light increases in proportion to the current. In this way it was found that the quantity of light which the Schuckert mirror receives from its lamp with horizontal carbons is in the ratio of 42,761 : 14,600, or 2.93 : 1 to the quantity of light the Mangin mirror receives from its lamp with inclined carbons.

If, therefore, the Schuckert mirror turns to as good account the light it receives as the Mangin does, which must be granted, then the quantity of light sent out from the Schuckert projector with its lamp with horizontal carbons will be in the ratio of 2.93 : 1 to the quantity of light sent out from the Mangin projector with its lamp with inclined carbons, assuming that in both lamps the same consumption of energy takes place. It will be seen, later on, that the photometrical measurements of the beams of light sent out by both projectors satisfactorily agree with this.

Through measurements and calculations carried out in the same way, it has been found that if a lamp with horizontal carbons is placed in the Mangin projector, the quantity of light received by the mirror of this projector is in the ratio of 21,276 : 42,761 or 1 : 2.01 to the one the Schuckert mirror receives in using the same lamp. Under exactly equal conditions, therefore, the Schuckert projector will produce double the quantity of light of the Mangin projector or, taken absolutely, the Schuckert projector has double the effective value of the Mangin projector.

In the previously given theoretical considerations the effective value of both mirrors was found to be 1 : 2.11, which agrees satisfactorily with the above. It will also be seen later on, that the photometrical measurements of the beams sent out from both projectors satisfactorily confirm this.

From these results it has further been found that, if the lamp with horizontal carbons is placed in the Mangin projector, more light must be obtained in the proportion of 21,276:14,600 or 1.46:1 than if the lamp with inclined carbons is used. This means that the lamp itself raises the quantity of light by 46 per cent. This has also been proved by the photometrical measurements, described later on, of the beams of light produced by both lamps.

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[1] From "*Mittheilungen aus dem Gebiete des Seewesens*', by the Imperial Austrian Hydrographic office," Vol. xx, Nos. 2 and 3.

2. The word "surface-intensity" which we introduce, is in a sense synonymous with the expression "metre-candles," used by Weber for "lighting-intensity."

Although as far as I know, Sautter-Lemonnier were the first (I heard of it already in the year 1879) to carry out exact measurements to ascertain the relation between the light given out by arc-lamps under different angles and with different positions of the carbons, they only intended to find out such an arrangement and position of the carbons as to get the lamp to throw the most light in a horizontal direction, which means against the mirror,—without trying to distribute the light evenly over the whole surface, which has been done in the experiments described here.

In fact the distribution of the light over the mirror in using the lamp with inclined carbons is most uneven and disadvantageous. The surface intensity of the light in the most favorable zone (this is here the central part) is in the ratio of that of the most unfavorable zone (the outer edge) as 9.72 : 2.69. or 3.6 : 1. The central part of the mirror, however, comes less into account in consequence of it being covered by the screen of the lamp.

But if the lamp with the horizontal carbons is used, the relation between the surface-intensity of the most favorable zone (here about 36 deg.) and the one at the edge is 18.9 : 12.0 or 1.57:1. The light is therefore distributed more evenly and favorably over the mirror. The most unfavorable zone is in the centre at the distance of about 10 deg. which answers to about 2.5 centimetres in the distance of the lamp and which is, besides, covered by the carbon holder.[1]

It may further be mentioned that the mean surface intensity of the light falling upon the mirror, expressed in the manner described in the beginning, has been found to be 4.6 for the Mangin projector with inclined carbons and 5.4 with horizontal carbons, and for the Schuckert projector with horizontal carbons 13.7.

To be able to judge practically of the efficiency of both projectors, and also for the purpose of measuring with the photometer the beams of light sent out from the same, both projectors were placed side by side on board ship, and on the first evening, always using equal current (64 Amp.) the visibility of lighted objects only and their details were studied by several observers. The objects were placed at a distance of 1,100 to 2,700 metres from the projectors. The observers stated that the objects were much better visible and clearer with the Schuckert projector, the latter having, besides, a much larger illuminated field. The results remained equally favorable for this projector, whether concentrated light, fully spread light or light dispersed with the dispersing lens was used.

The measurements with the photometer were carried out at a distance of 1,100 metres from the projectors and repeated on two consecutive evenings. The results of these measurements were used in the way explained at the beginning to calculate the surface intensity and the quanity of light. The results thus obtained are given in the following table. The figures given for the quantities of light are of course only to be looked upon as relative and not as absolute. But as they have been obtained from both projectors in exactly the same manner, they give the proper expression of the relative value of both.

The rates of the surface-intensities with which the Schuckert and Mangin projectors illuminate a surface at equal distances and using the same sourse of light, is therefore according to the above average results as 17.0 : 13.1, or 1.3 : 1, *i. e.*, the brightness of the lighted surface is 1:3 times greater with the former projecter than with the Mangin projector, which agrees with the previous calculation.

It further follows that under like conditions and with a concentrated beam the quantity of light sent out from the Schuckert projector if in the ratio of 43,350 : 20,147 or 2.1 : 1 to that of the Mangin projector which also satisfactorily coincides with the calculated result and with the one which has been found from the quantity of light falling upon both mirrors.

Further, the proportion of the quantity of light sent out by the Schuckert projector with horizontal carbons to the one sent out by the Mangin projector with inclined carbons is found to be 43,350 : 15,732=2.76 : 1. This proportion also agrees with the one arrived at from the measured quantities of light sent out from the lamps to the mirrors (2.9:1).

Lastly it follows, that the Mangin projector combined with a lamp with horizontal carbons sends out more light in the proportion of 20,147: 15,732=1.3 :1, than if using a lamp with inclined carbons, and this too satisfactorily agrees with our previous result (1.4 : 1).

The following might be interesting enough to be mentioned, though strictly speaking it does not come under the heading of this article. At 10 o'clock in the evening of July 21, the sky being clear and the atmosphere quite transparent, the surface intensity, with which the surface of the earth is lighted by the full moon, measured and expressed in the manner described above, was found to be 16.5×10^{-5}.

As the Schuckert projector with concentrated light at 1,100 metres distance gives a surface intensity of 22.7×10^{-4}, the brightness produced by the projectors at this distance is greater in the ratio of $22.7 \times 10^{-4} : 16.5 \times 10^{-5} = 13.8 : 1$, than the one produced by the full moon. Therefore the beam of a Schuckert projector would produce at four kilometres distance the same brightness of light as the full moon does. At two o'clock in the afternoon of the same day the sun lighted a horizontal white surface, shining directly upon it with a surface intensity of 12, vertical surfaces with 9.2 and in the shadow of the house, *i. e.*, in diffused and reflected light, with a surface intensity of 2.4.

Results of the Photometrical Measurements Taken on the Beams of Light, Sent Out From the Mangin and Schuckert Projectors.

(*Strength of Current*, 64 *Amp.*, *Distance Between Photometer and Projectors*, 1,100 *Metres.*)

Projector. 60 cm. diameter.	Lamp.	Light.	Surface Intensity ($\times 10^4$) at 1,100 metres distance from the projector.		Dispersion-angle.	Lighted area at 1,100m. distance.			Calculated quantity of light.
			Largest.	Middle.		Diameter, viz. height metres.	Length metres.	Area square metres.	
Mangin.	Inclined carbons.	concent.	11.5	11.4	2.2°	42.2	.....	1,380	15,732
		disper.-lens	3.05	2.4	11.1°	42.2	215.8	9,115	21,876
		fully disp.	4.0	....	5.3°	101.9	.....	8,132	......
Mangin.	Horizontal carbons.	concent.	16.3	13.1	2.3°	44.2	....	1,538	20,147
		disper.-lens	4.0	3.9	10.6°	44.2	204.1	9,021	35,182
Schuckert.	Horizontal carbons.	concent.	22.7	17.0	3°	57.6	.....	2,550	43,350
		disper.-lens	3.8	2.9	27°	57.6	524	30,184	87,530
		fully disp.	4.5	....	6.2°	112.6	.....	11,150	......

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[1] It may be mentioned, that Siemens & Halske exhibited a projector at the electrical exhibition in Vienna (1883), the carbons of which had been arranged horizontally.

ELECTRICAL LECTURES FOR THE WORLD'S FAIR.

The magnificent building that will be devoted to electricity at the World's Fair should have special interest for shoe and leather manufacturers, says *Hide and Leather*. Electric lighting and power are gaining rapidly in popularity in our trade. Exhibitors of such appliances will no doubt be willing and ready to furnish desired imformation freely. In connection with this it might be an excellent plan for a certain time to be allotted for lectures or addresses on the advantages of the application of electricity for various manufacturing industries Many who are not now acquainted with the wonders of electricity might be induced to change their minds if they listened to electrical experts. We trust that the valuable papers published in the interests of electricity will take up this matter and use their powerful influence on behalf of a series of industrial lectures on the subject mentioned.

AN ALLOY DYNAMO BRUSH.

A new dynamo brush recently introduced in France, is said to be a great improvement on those usually used there. It consists simply of a pile of exceedingly thin sheets of a copper alloy possessing anti-friction properties. The sheets are about one-thousandth of an inch thick. They are made to last longer than those made of copper netting so often used abroad, and probably wear the commutator less. It has been pointed out, however, that the resistance of the alloy compares unfavorably with that of copper brushes.

ELECTRIC INSTALLATIONS AND SOME RADICAL CHANGES IN GENERAL SYSTEMS OF WIRING.[1]

BY C. G. ARMSTRONG.

THE author began by drawing attention to the fact that while making provisions for all kinds of conduits, such as water, gas, sewerage, ventilating, etc., architects rarely provided space for electric conduits, or for the electric plant in general, with the result that the latter is frequently placed at a disadvantage. Considering the cramped space allowed for dynamos, there was great need at the present time for a direct-connected slow-speed dynamo of small capacity. The author preferred to put dynamos as close together as possible, the two conditions to be observed being (1) that they shall not be reversed by the proximity of like poles, and (2) that the armature of any machine can be removed without disturbing the other. The author advocated a strong foundation for dynamos, consisting of concrete or brick, surmounted by a strong wooden frame bolted to it and the dynamo bolted to the wooden frame. The latter should be previously soaked and thoroughly painted with insulating and waterproofing compound.

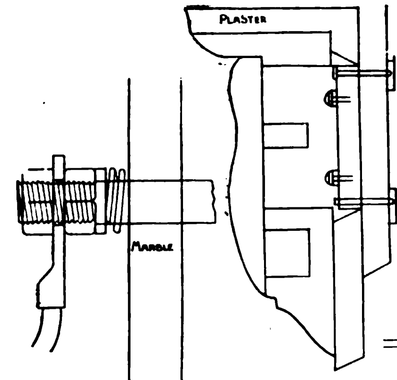

FIG. 1.

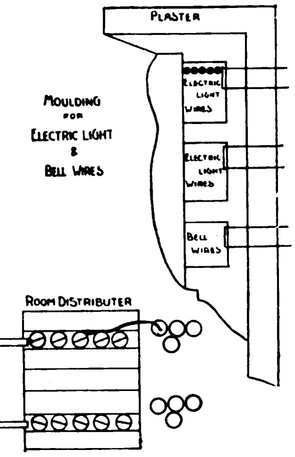

FIG. 2.

The switchboard should be placed within 6 or 8 feet of the commutator. The author preferred Tennessee marble for such boards as it stains less easily than white marble. Precaution should be taken in fastening instruments to such boards. Owing to the unyielding property of marble or slate it is advantageous to have a coil spring and to make connections as shown in Fig. 1; otherwise the instruments will become loose by the jarring of the board. Bus bars are better than any other connection, in the estimation of the author. Where the motor load amounts to quite a considerable portion of the load a third bus bar ought to be used for motor connections; this, of course, applies only to such plants as have two or more dynamos. The author showed a large number of views of switchboards.

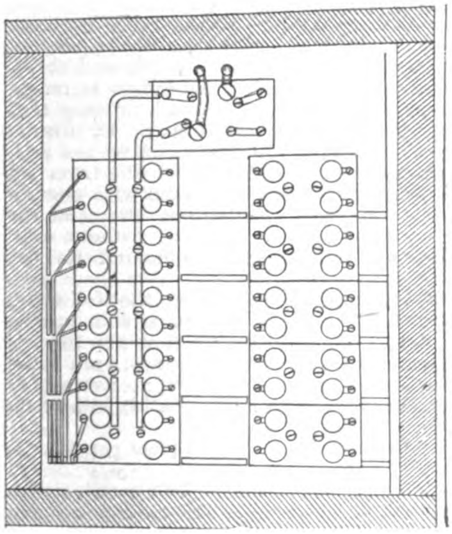

FIG. 3.

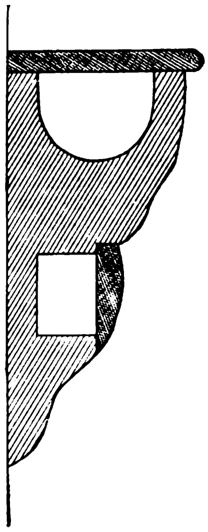

FIG. 4.

Taking up the question of wires for electric lighting the author said he did not believe in testing them by soaking in chloroform, naphtha, etc., as wires were not subjected to such influences in ordinary practice. The greatest enemy of wire was ammonia, which was present in all plastering. Still another danger lay in the use, by painters, of an acid wash. This acid, acting on the nitrates in the plaster, generates ammonia which attacks the rubber insulation. The only protection against ammonia known to the author was a waxy covering which is used on the best grades of weatherproof wire; this covering was also a preventive against the attacks of rats and roaches, who were fond of rubber.

The present method of distributing wires in fireproof buildings is: (1) Wire placed directly beneath the plastering with cleats. (2) All wire enclosed in interior conduit tubes. (3) The most desirable method, is the running of wires from the cut-out cabinets in molding to the rooms and then under the plastering in interior conduit tubes to the outlets. The author uses the latter method almost exclusively. Fig. 2 shows one form of corridor-molding used by him. It has three compartments, one for each polarity of the lighting wire and one for the bell wires. After leaving this molding, interior conduits carry the wires to the outlets. This was a better method than the exclusive employment of interior conduits, as architects were every day limiting the thickness of plastering. But the greatest objection to running interior conduits clear back to the cut-out cabinets was that a large number of tubes are brought to one point, and that it was almost impossible to make plastering adhere to them. The author objected seriously to laying conduits in flooring, as they were liable to be broken by workmen. He also objected to the indiscriminate use of interior conduits, as a slight settling of the building is apt to break them, thus rendering them of little use. While using them in 95 per cent. of his work he believed in restricting them to short runs between outlets, and some form of molding to carry the wire back to the cut-out cabinets.

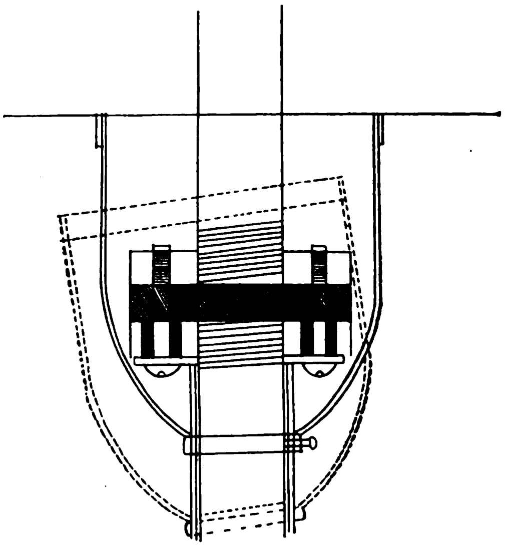

FIG. 5.

For convenience of testing, the author uses an individual distributor in each room. This consists of a horseshoe cut-out, having no fuses, placed in the centre electrolier of a room, from which a circuit runs to the different outlets. Or, where it is possible, use is made of the block shown in Fig. 2, placed in the molding at the entrance to each room.

The three points of danger in electric lighting plants are, (1) the switchboard; (2) the cut-out cabinets; and (3) the liability to grounding of the circuit. The author advocated the use of cut-out cabinets such as that illustrated in Fig. 3; this is made of slate or marble. He was also in favor of bunching the distributing wires together, wires of opposite polarity being placed side by side in the same raceway, shown in Fig. 4; this raceway should be lined with asbestos paper and coated with fireproof paint, or made of fireproof material throughout.

The author would limit the current allowed on any one circuit to eight amperes, and every fixture ought to be provided with an insulating joint, which must also carry the canopy. Fig. 5 illustrated a case frequently met with, the canopy forming a connection between both sides of the insulated joint and thus making the latter of no avail. No drop cord smaller than No. 16 and no wire smaller than No. 14 ought to be used. The author advocated the indiscriminate mixing of polarities in wires, as a protection against the dangerous "sneak-currents." On this system a short circuit would very quickly develop and blow the fuse and thus warn the electrician in charge that something was wrong.

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[1] Abstract of a Paper read before the Chicago Electric Club, Feb. 20, 1893.

The object of limiting the current on a circuit to eight amperes was to reduce the liability of destroying sockets by short-circuiting. The author believed in putting in plenty of copper and designing the circuits for a small loss at the average load.

EDWARD WESTON ON THE INCANDESCENT LAMP FROM A COMMERCIAL STANDPOINT.[1]

Mr. Weston pointed out that the modern incandescent lamp consisted essentially of the carbon conductor, the glass envelope and the leading-in wires, and that the creators of the art of electric lighting understood the subject a great deal better than they are given credit for by many. The erroneous impressions which early got abroad with respect to the feasibility of electric lighting by incandescence were due to writers who based their information and calculations on false premises or who were swayed by sentiment or business interests. Mr. Weston demonstrated by an example the errors into which some of these writers fell. These errors were also made with regard to arc lighting notwithstanding that both he and Mr. Brush had already quite economically run arc lights in series.

Coming to the question of the most efficient and durable lamp, Mr. Weston stated at the outset that, with a given kind of carbon, as the efficiency is increased the life is decreased. It was not always true, however, as claimed, that the very noticeable difference in the durability of the various lamps is solely due to differences in their efficiency. In the opinion of Mr. Weston Mr. Townley's classification of carbons, based on certain of their characteristics, was too restricted, because the practical value of a lamp depended very much on the physical characteristics of the base from which it was made. He would propose the following classification: 1. Carbons made from cellulose, the physical characteristics of which have been modified by some process of manufacture which has more or less broken up the fibres or re-arranged them and bound them together mechanically. Under this head come paper, cotton or linen thread, or braid, and silk thread or braid 2. Carbons made from the previously-named manufactured products, but subsequently subjected to some chemical process, such as parchmentizing, to cement the fibres more closely. 3. Carbons made from wood split in the direction of the fibre. 4. Carbons made from any one of the above and exposed to the hydro-carbon treatment. 5. Carbons made from a perfectly homogeneous base.

The carbon resulting from the use of any one of these primary bases had precisely the same structure as the original base. Hence an untreated carbon made from paper was defective, and a lamp made with a paper carbon would probably not exceed 150 hours of life. Mr. Weston then entered into a description of some of his early work in producing carbons for incandescent lamps, and related how he devised the method of flashing in hydro-carbon vapor, which has now become so universal.

Regarding the second class of carbons, the hydro-carbon treatment was nearly as essential with these as with the carbons of the first class, due to the existence of defective spots as well as the necessity of equalizing the resistance of the carbons. As regards the third class, namely, untreated or natural carbons, much variation in electrical resistance must inevitably be encountered, unless they be submitted to some subsequent process after the first baking. The fourth class or flashed carbons are superior to the unflashed.

In order to obtain the best results, an absolutely homogeneous carbon was necessary, and Mr. Weston many years ago worked to obtain that end and succeeded by securing a base of perfectly homogeneous quality. The method of obtaining this base was fully described in his U. S. Patent, No. 264,987, of Sept. 26, 1882. The characteristics of the carbon and its advantages were set forth in another patent, No. 264,986, Sept. 26, 1882. Within the past year Mr. Weston had made many improvements in the method of making these carbons. Such a carbon required no treatment for use in the lamp. It made a most efficient and durable lamp, and yet it could not be obtained in the market. The reason why it could not be, would hardly be satisfactorily answered by those conducting the manufacturing branch of the business.

Mr. Weston in referring to the "stopper" lamp failed to see anything new in it. He believed that neither of the two large companies manufacturing lamps were giving the best they could to the central station manager.

It was claimed that 2½ watt lamps could give a satisfactory light. He believed this possible with good low voltage lamps under close regulation, as it had been known for years that a good low voltage lamp is more efficient then and quite as durable as a high voltage lamp.

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[1] Abstract of the remarks made by Mr. Edward Weston in the discussion of Mr. C. Townley's paper read before the National Electric Light Association at St. Louis. See Electrical Engineer, March 11.

THE "INCANDESCENT ARC" LAMP AS A RIVAL TO THE INCANDESCENT LAMP.

BY

Augustus Noll

In contemplating the latest and most economical method of lighting stores, large places, streets, etc., by the use of low tension arc lights, commonly known as "incandescent arc lights," it may be interesting to refer to the early days of electric lighting, and to show the different ideas and demands, which have developed up to the present time.

Ten years ago the general standard or basis on which to calculate the amount of light required for a given space was one five-foot gas burner, or one sixteen candle-power incandescent electric lamp, to one hundred square feet; or, a space or room 10 x 10 feet required one burner or lamp, as mentioned above. Since that time, however, the public have desired, and storekeepers especially have been compelled, by the changed conditions, to use more light, in the same area, so that to-day, in some of the stores on the leading thoroughfares in New York City, the proprietor is really compelled, if he wishes to have his store or wares present an attractive appearance in comparison with his neighbors, to use a sixteen candle-power lamp to every forty, thirty, and even as low as twenty-five feet, so that a store being 25 x 100 feet, will sometimes require 100 16-c. p. lamps; and if the nature of the business is such that it compels him to keep open evenings, the expense for light is very large, and he has, no doubt, often wished for a cheaper method of illumination, and one offering the same advantages as the low tension incandescent electric light system, namely, steadiness, silence, no interruptions, and rays which are pleasing to the eye.

A system comprising all the above elements is now available, and while its use at the present time is not as extensive as the incandescent lamp system, it will become so without doubt. Even now it is rapidly superseding the incandescent lamp system for lighting stores, hotels, halls, lobbies of theatres, lecture halls, factories, and all places where general illumination is desired, and the method employed involves the use of the low tension arc lamp, reference being here made only to those used on the direct low tension current.

Heretofore, when arc lights were mentioned, the public would immediately picture in its mind the unsightly appearance, harshness and intensity of light, and the flickering and hissing of the ordinary high tension arc lamps, the danger to life and property, and very properly would not even consider a proposition to illuminate any premises by the use of such a system. But with the use of low tension direct current arc lamps, the conditions are altogether different, and the results highly satisfactory, which is fully attested by those using the system, and the rapid increase in the number of installations.

After years of experimenting and at considerable expense, every detail has been worked out and perfected, so that to-day an arc lamp can be made to operate with absolute silence and steadiness. The wide field and general use of these lamps is recognized and considerable capital has been invested, proving that the lamp and method of lighting have come to stay. Until quite recently the appearance of the lamps was objectionable, but now they are manufactured in various designs, which, from an artistic standpoint, will stand favorable comparison with electroliers, chandeliers, lanterns, brackets, newel-posts, etc., and the soft and mellow light, its steadiness and silence, without even considering the low cost of maintenance, commend its use almost universally.

Regarding the cost of lighting, let us assume the following condition: A store lighted by incandescent lamps and current furnished from central station, and sold at one cent per 16 c. p. lamp per hour, the consumer using 100 16-c. p. lamps, each rated at ½ ampere at 110 volts, and using the same on an average of four hours per day throughout the year; his monthly bill would be:

100 (16 c. p. lamps) x 4 (hours) x 30 (days) x 1 (cent per 16 c. p. lamp) = $120.00 per month.

The capacity in candle-power = 100 x 16 = 1600 candle-power and to operate them requires 50 amperes = 32 candle-power per ampere.

Assuming the same store or area to be lighted by 4–1500 c. p. incandescent arc lamps, at an average of 4 hours per day, each pair consuming 8 amperes = 16 amperes. Then the total candle-power = 6000; and the cost per hour would be 16 (amperes) x 2 (cents per ampere) = 32 cents per hour, and the consumers monthly bill would be:

16 (amperes) x 2 (cents) x 4 (hours) x 30 (days) = $38.40. The difference in cost between the two methods would be:

	Total c.p.	Cost per hour	Cost per day	Cost per month
Incandescent lamp	1600	$1.00	$4.00	$120.00
" arc "	6000	.32	1.28	38.40

This shows a difference in favor of the incandescent arc lamp method, as against the incandescent lamp method, of about 12 to 1 for the same amount of money. When we consider that the lighting is at all times at the disposal of the consumer, and is not turned on or off at the station at certain times, as in the case of high tension circuits, but is controlled in the same manner as incandescent lamps, that is, by means of a switch, and that the same low pressure is used, making it absolutely safe from fire, shocks, etc., all this together with the enormous increase in candle-power without increased cost, appeals very strongly to the judgment of the consumer.

In the case of an isolated lighting plant, assuming the dynamo to have a capacity of 100 amperes furnishing current to 200 half-ampere 16 c. p. incandescent lamps, the total output 200 x 16 = 3,200 c. p., or 32 c. p. per ampere.

The same plant, when using incandescent arc lamps, would generate sufficient current to operate 12 pairs of lamps, each pair consuming eight amperes, and the candle power of each lamp would equal 1,500. The total capacity would equal 1,500 x 24 = 36,000 c. p., or 375 c. p. per ampere.

For a further example, assume a lighting plant, generating current to light 160 16-c. p. incandescent lamps, each lamp rated at 3.1 watts per candle power, equal, roughly, to 50 watts per lamp. This gives a total capacity of 160 x 50 = 8,000 watts, and in horse power $= \frac{8000}{746} = 10.73$; and rating the consumption of coal at 4 pounds per horse power hour = 42.92 pounds of coal per hour, by this system we would secure:

Total candle power	2,560
Candle power per 50 watts	16
" " " horse power	238
" " " pound of coal per hour	59.5

The total candle power of this plant can be maintained for a period of 46.6 hours, with a coal consumption of one ton, which, assuming the cost of coal to be $4.00 per ton, gives 2,560 c. p. at $4.00.

Assuming the same plant in generating capacity, but with the use of incandescent arc lights:

Capacity in amperes	80
" " watts	8,000
Coal consumption per hour, in pounds	42.92

Assuming that we used 10 pairs of lamps, each pair requiring eight amperes, and each lamp rated at 1,500 c. p., the total candle power would be 20 x 1,500 = 30,000, and we would have:

Candle power per 50 watts	187.5
" " " horse power	2,797.5
" " " pound of coal per hour	699

The price of carbons was excluded in the above examples, on the assumption that the cost of renewal of carbons and lamps would be nearly equal.

While the examples are based on using eight-ampere lamps, they are made for any amperage from 2.5 amperes up to 20, or even greater, if desired. The length of time before renewal of carbons becomes necessary is regulated by the length of the feed rack or band, and the length of the carbon, and single carbon lamps are made to burn 12, 14, 16 and even 18 hours.

The candle power is regulated by the quantity and pressure of the current passing through an arc and the mechanism of the lamp has nothing whatever to do with it, as its function is to hold the carbons a certain distance apart, and as the carbon is being consumed it is released and allowed to drop to a point equal to that originally maintained.

In a general way, an arc lamp to be satisfactory should meet the requirements of the Board of Fire Underwriters, and be so constructed that when the current is turned on, it will "pick up" its arc quickly and silently, and the feeding arrangement should be regulated to feed the carbon at a rate equal to its combustion; from a mechanical standpoint, the parts should be as few as possible and all delicate adjustments should be avoided; series coils and dash pots should also be eliminated, as they simply invite trouble and hide more serious defects; both poles of the circuit should be thoroughly insulated, and the carbon holders should be arranged in such manner that carbons can be renewed without taking off the globe; also that the globe can be taken off without interfering with the carbons. Each lamp should have an arrangement whereby the current is automatically cut off when the carbon has been consumed to a certain point.

With the great improvements recently made in incandescent arc lamps, this method of lighting bids fair to supersede all others, for lighting where general illumination is desired. Illuminating companies are already considering the advisability of using the incandescent arc lamp more generally, as the increase of output for the same amount of power expended, is considerable. For street lighting it offers advantages over all other systems, and has been fully tested and is now in operation. On Fifth avenue, the most fashionable thoroughfare in New York City, 118 lamps are arranged in series of two, on each post. The posts are of iron, highly ornamental, with cap and brackets of wrought iron. All the wires enter the post at the base; a door is fitted at the lower portion of the post with resistance and switch for turning on or off each post; also with arrangement for raising and lowering each lamp. All the main wires are underground; each pair of lamps consumes only five amperes, and each post is a complete system, being independent of every other, and the lights can be turned on or off without affecting any of the rest.

As far as the writer is aware, it is the only street in this country lighted in this manner and the results are highly satisfactory, the posts presenting a neat and ornamental appearance. The current is furnished by the Edison Electric Illuminating Company of New York, who also installed the system; during the Columbian celebration, the lamps were very favorably commented upon by many. The idea of lighting the street in this manner originated with Mr. R. R. Bowker, the vice-president of the Edison Electric Illuminating Company of New York, and the whole was installed under his direction. The posts and lamps were furnished by the General Incandescent Arc Light Company, of New York. It is to be hoped that in a short time other streets will be lighted in the same manner, doing away with the danger and unsightly appearance of overhead wires.

PERSONAL.

DR. F. A. C. PERRINE.

Dr. F. A. C. Perrine, who has for the past year been the treasurer of the Germania Electric Company, of Boston, has resigned his position, and has just been appointed Professor of Electrical Engineering at the Leland Stanford, Jr. University, Palo Alto, California. He will enter his new duties at the beginning of the ensuing college year about August 1, before which time he will make a thorough investigation of all the latest designs of electrical engineering apparatus, both in the factories of the various companies, and at the exhibits at the World's Fair in Chicago. Dr. Perrine is well-known to electricians in the United States, and has up to the present time had a remarkably successful career. Educated at Princeton University, which he entered in 1879, the degree of A. B. was conferred upon him in 1883, D:Sc. in 1885, and A. M. in 1886. After leaving the university, he entered the service of the United States Electric Light Company in Newark, N. J., as assistant electrician, which position he held for three years. Thereafter he was appointed superintendent and manager of the insulated wire department of the John A. Roeblings Sons' Company, at Trenton, N. J., in which capacity he served for four years with great credit to himself and with the full confidence of the Roeblings. About a year ago Dr. Perrine went to Boston, to act as treasurer of the Germania Electric Company, and has made for himself a large number of friends in their vicinity, and conducted the affairs of the company with great success. For years Dr. Perrine has devoted a large part of his spare time to writing and scientific investigation and has produced much valuable data and information relating to electrical engineering. He now starts out on his new career with the best of wishes of hosts of friends in the East. Dr. Perrine is eminently fitted by education and natural desires for his new position, and Leland University is to be congratulated upon securing the services of so able and energetic an electrician for her electrical engineering course.

Mr. W. S. Andrews has resigned his position of General Superintendent of the Works of the Canadian General Electric Co., Limited, at Peterborough, Ont., Canada, to assume the management of several large electric light and power concerns in Pennsylvania. His experience in this business dates from 1883, when, in connection with Mr. Frank J. Sprague, he put in the first Edison three-wire Central Station plant at Sunbury, Pa., and since that time, a great number of Edison light stations have been installed and started under his supervision. Among these may be mentioned Harrisburg, Williamsport, and Lancaster. Pa., Rochester, N. Y., New Orleans, La., Chicago, Ill., and Minneapolis, Minn. Mr. Andrews began his electrical career with Mr. Edison, at Menlo Park, in 1879, and ever since that date he has been intimately and constantly connected with the manufacture, setting-up and running of electric light and power machinery. His long training in these fields of work will be of especial value to him in his new position.

Mr. Frederick Sargent has resigned his position as the general manager of the mechanical and electrical engineering department of the World's Fair. Just what it all means, nobody knows, but it is understood that Mr. Sargent was on the point of resigning half a dozen times before, owing to the annoyance and vexations of a very delicate position. Recently, a legal dispute arose between the Babcock & Wilcox and

Stirling Boiler Companies, in which the former was defeated, although Mr. Sargent had supported it, in its claims to exclusive boiler privileges in the service exhibit. This complication is probably the underlying cause of the resignation, as, it is said that President Higginbotham, lately elected, is personally friendly to the Stirling Company, and had espoused its cause. Messrs. R. H. Pierce and C. F. Foster are expected to carry on and complete the work which Mr. Sargent has conducted so well, and with such magnificent results.

Mr. Frederick A. Scheffler, Superintendent of the Brush Electric Company, Cleveland, Ohio, has tendered his resignation to take effect April 1. Mr. Scheffler has for several years past been actively identified with the manufacture of electrical apparatus, and, for a number of years previous, was engaged in the production of steam engines and boilers. His address, after April 1, will be "Passaic, N. J., care of E. K. Rose."

OBITUARY.

SAMUEL BOARDMAN.

Mr. Samuel Boardman, President of the Bishop Gutta Percha Co., and senior member of the law firm of Boardman & Boardman, 155–157 Broadway, N. Y., died at his residence in Newark, N. J., on Tuesday, 14th inst. Mr. Boardman was born in Manchester, England, in 1816. He came to New York in 1832, studied medicine here, and soon after being admitted was appointed surgeon at the U. S. Arsenal, Chattahoochie, Florida. Florida was at that time a territory, and General Taylor was stationed there prosecuting the Seminole War.

A few years later Mr. Boardman was appointed commandant of the arsenal with rank of captain. He remained in that position for several years, filling the offices of surgeon and commander of the arsenal and postmaster of the station, but on account of failing health he decided to return to New York.

He studied law for two or three years before resigning his post at Chattahoochie, and in 1853 came to New York, entering the office of Benedict & Boardman, which firm he soon joined as partner. The late Charles O'Connor was a member of the same firm. Mr. Samuel Boardman was the last survivor of the old partnership, which for many years stood in the front rank of law firms, giving good law for a good price, and keeping out of politics. Mr. E. C. Boardman, nephew of the deceased, for several years has been the active head of the firm.

Mr. Samuel Boardman in his younger days was a prominent mason, reaching the position of Deputy Grand Master of the Grand Lodge in Florida. One of his first clients in New York was Samuel C. Bishop, the proprietor of the Bishop Gutta Percha Works, who was also an enthusiastic mason. Mr. Boardman was attorney for Mr. Bishop until the death of the latter, which occurred in 1872, and afterwards for Mrs. Bishop, in whose name the Gutta Percha Works were conducted until her death in 1881.

Mr. Boardman continued the business until 1885, when he organized the present Bishop Gutta Percha Co. of which he remained president until his death. He was for many years a member of the Manhattan Club and of the Bar Association of this city.

D. A. ANDREWS, SR.

Our readers will be sorry to learn of the death at Washington, D. C., on the 11th inst., of Mr. D. A. Andrews, Sr., of the well-known firm of the Pettingell-Andrews Company of Boston. Mr. Andrews had not been in very robust health for some time, though he was in daily attendance at business, and had gone to Washington to attend the inauguration ceremonies, in the hope that the rest and change would prove beneficial. The day before inauguration Mr. Andrews was taken sick, but recovered sufficiently to be able to attend the ceremonies and witness the procession. The exposure to the cold, however, proved fatal. He was immediately taken seriously sick, and was confined to bed in a friend's house. His sickness rapidly developed into inflammatory rheumatism, and one week after he was taken sick he died at his friend's residence attended by his wife, who, fortunately, had accompanied him to the capital. His son, Mr. D. A. Andrews, Jr., left Boston on Saturday for Washington, but unfortunately did not reach the city until too late. The funeral services took place on Tuesday, the 14th inst., from Trinity Church, Boston, Dr. Donald officiating, a large number of his personal and business friends being in attendance at the church. Mr. Andrews was born in Providence between 55 and 60 years ago, and first became connected with the electrical business in Boston about five years ago, when he entered into partnership with Mr. F. E. Pettingell, under the title of Pettingell & Andrews. Their place of business was at that time at the corner of Franklin and Congress streets, but about two years ago they moved to their present quarters at 196 Summer street, the firm being afterwards changed to the Pettingell-Andrews Company. Mr. Andrews never took much active interest in the selling department, confining himself closely to office work, but was well known to a large circle of business men, who admired him for his absolute integrity, and straight-forward business methods and uniform courtesy. He will be much missed and widely mourned, and his general influence over the welfare of the company will be difficult to replace. The business will be carried on as usual by his son, Mr. D. A. Andrews, Jr., and Mr. Charles A. Price, both well and favorably known to the electrical trade.

LETTERS TO THE EDITOR.

A WALLACE DYNAMO IN WASHINGTON IN 1878.

In connection with Mr. Hammer's sketch of the work of Mr. Wallace as a pioneer in electrical work, I may add that in 1878 he sent one of his dynamos to Washington and had it set up in the Capitol, for the purpose of lighting the Senate Hall with electricity.

The arrangement was made with him to do this, by A. H. Byington of the *Norwalk Gazette*, and myself, Mr. Byington being at the time clerk of the Senate Committee on Patents. The intention was to use arc lights above, to throw the light down through the figured glass ceiling into the hall below. We tried a single light, but as we could not get the proper speed on the dynamo, (as temporarily set up) the light flickered; and as the officials looked askance at the innovation and would give us no encouragement, the enterprise was therefore abandoned and the dynamo sent back. I still have one of Mr. Wallace's flat carbon arc lamps, which he patented December 18, 1877.

W. C. Dodge.

Washington, D. C., March 11, 1893.

LEGAL NOTES.

INCANDESCENT LAMP LITIGATION.

In the U. S. Circuit Court, Boston, before Judge Colt, Mr. F. P. Fish, attorney for the General Electric Company, appeared on March 17th to apply for an injunction against the Germania Electric Company, of Boston, and also against the Boston Incandescent Lamp Company, of Boston. Neither company put in any defence, but filed pleas concurring in the injunctions, which were duly granted. The injunctions in these cases are perpetual, as there will be no further hearing.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED FEBRUARY 28, 1893.

Alarms and Signals:—

Electric Train Controlling Apparatus, F. E. Kinsman, Plainfield, N. J. 492,402. Filed Feb. 24, 1892.

An electric block systems by means of which a train entering an occupied block is immediately brought to a stop independently of the engine man.

Means for Operating Throttle Valves of Steam Engines, F. E. Kinsman, Plainfield, N. J., 492,403. Filed Feb. 24, 1892.

Similar in its object to 492,402.

Electric Burglar Alarm, C. F. A. Sturts, San Francisco, Cal., 492,478. Filed Sept. 30, 1891.

Electric Signaling Apparatus, W. H. Kenyon, New York, N. Y., 492,497. Filed June 3, 1892.

An automatic electric block system for railways.

Electrical Annunciator, J. R. Hard, New York, N. Y., 491,519. Filed Oct 8, 1892.

Provides a catch for the operating weight adapted to be disengaged by a very weak current but to resist detachment by jarring or shaking.

Electric Signaling Apparatus, W. Trafford, New York, N. Y., 492,545. Filed Oct. 17, 1891.

A multiplex signaling apparatus consisting of sub-station alarm apparatus in separate rooms, the action of which is governed by a clock in the main office.

Electric Railway Signal, H. St. C. Wait, New York, N. Y., 492,645. Filed Aug. 11, 1891.

A device by means of which the official in charge of each section of a road may see at a glance the position of all the switches, signals, and trains thereon.

Electric Alarm Money Drawer, W. J. Walker, St. Louis, Mo., 492,646. Filed Oct. 29, 1892.

Electric Alarm for Hotels, J. McMurrow, Jr., Philadelphia, Pa., 492,694. Filed July 21, 1892.

An automatic alarm which not only rings a bell but lights an electric lamp or a gas fixture.

Railroad Crossing, W. C. Fletcher, St Louis, Mo., 492,770. Filed 27, 1892.

An automatic electric device for preventing collisions at railway crossings.

Distribution:—

Electric Lighting System, R. W. Rollins, Hartford, Conn., 492,633. Filed Aug. 16, 1892.

Relates to means by which two or more independent circuits, each having a separate constant-current dynamo can be united in pairs by a single conductor which will form a path for the current of both circuits in the same direction or a path for either current while the other is broken.

Dynamos and Motors :—

Ceiling Fan, F. H. Beers, Newark, N. J., 492,523. Filed Oct. 24, 1891.

Electric Motor, F. H. Beers, Newark, N. J., 492,524. Filed Apr. 2, 1892.

A small electric motor for use in the operation of independent ceiling fans.

Armature for Dynamo-Electric Machines, G. Hoare, Newark, N. J., 492,681. Filed Mar. 24, 1892

Has for its object to provide a winding securing perfect mechanical balance and improved means for holding the driving pins in the head of the armature.

Galvanic and Thermo-Electric Batteries :—

Battery Jar, J. F. McLaughlin, Philadelphia, Pa , 492,422. Filed June 2, 1890.

A wooden jar having an insulated lining and metallic corner binding-pieces which serve as terminals for the electrodes.

Lamps and Appurtenances :—

Electric Arc Lamp, W. P. Wiemann, Alleghany, Pa., 492,650. Filed Apr. 18, 1892.

Employs a pivoted balanced counter-poise geared directly with the rack of the carbon carrier.

Metal Working :—

Welding Metals Electrically, C. L. Coffin, Detroit, Mich., 492,713. Filed Oct. 29. 1892.

Consists in subjecting the metal to the action of the arc at a short distance from the proposed seam, so that the metal is not charged by the action of the arc at the line of the weld.

Miscellaneous :—

Insulator Bracket, W. N. Eichberg, Chicago, Ill., 492,394. Filed Nov. 28, 1892.

A flexible bracket adapted to be placed upon trees or other supports likely to be subjected to movement.

Transformer and Means for Developing Rotary Magnetic Fields, C. S. Bradley, Avon, N. Y., 492,480. Filed March 17, 1892.

Comprises means for shifting the phases of the alternating current in two or more circuits of a transformer and by the combined action of the resulting currents developing the rotation of magnetism by which there may be induced in the secondary circuit as many phases as may be desired.

Coin Controlled Machine for Administering Electricity, W. R. Pope, New York, N. Y., 492,486. Filed Aug. 13, 1892.

Lightning Rod Ball, E. K. Hum, Pittsburgh, Pa., 492,512. Filed Sept. 24, 1892.

Keyed Musical Instrument Actuated by Electricity, P. E. Singer, London, England, 492,563. Filed June 17, 1892.

Detecting Apparatus for Coin Actuated Boxes, G. A. Tauberschmidt, Washington, D. C , 492,592. Filed Dec. 6, 1892.

Rheostat Plate, C. E. Carpenter, Bridgeport, Conn., 492,757, Filed Oct. 27, 1892.

A rheostat consisting of a base plate having thickened edges, a coating of enamel baked on its surface and resistance coils embedded in the enamel.

Rheostat Plate, C. E. Carpenter, Bridgeport, Conn., 492,758. Filed Oct. 27, 1892.

Consists of a base plate having ribs and a layer of enamel between each pair of ribs with the conductor buried in the enamel.

Production of Artificial Crystalline Carbonaceous Materials, E. G. Acheson, Monongahela City, Pa., 492,767. Filed May 10, 1892.

The method of producing carborundum. (See THE ELECTRICAL ENGINEER, Mar. 8, 1893.)

Railways and Appliances :—

Closed Electric Conduit for Railways, A. Heiser, Chicago, Ill., 492,398. Filed May 31, 1892.

Consists in the combination of the rail forming one side and part of the roof of the conduit and an adjustable casting forming the other side and the remainder of the roof.

Electric Railway Block System, F. O. Blackwell, Boston, Mass., 492,457. Filed Feb. 15, 1892.

Employs a sectional power supply conductor, circuit controllers normally keeping the supply conductor sections in circuit with the feeding conductor, and means kept in action during the presence of a car on any given section for cutting out of circuit the preceding section.

Electric Car Brake, W. C. Fletcher, St. Louis, Mo., 492,492. Filed Apr. 15, 1892.

Multiple Switch for Overhead Trolley Lines, W. H. Brodie, New York, N. Y., 492,526. Filed Sept. 29, 1892.

Apparatus for Electrically Propelled Cars, C. J. Kintner, New York, N. Y., 492,627. Filed July 30, 1892.

An automatic alarm bell for electric cars.

Electric Railway, M. Cattori, Rome, Italy, 492,659. Filed July 23, 1892.

Has for its object a simple railway in which the circuit breakers and their operating contacts will operate without sparking.

Conduit Electric Railway, J. H. Bates, Hoboken, N. J., 492,737. Filed Aug. 2, 1892.

Claim 1 follows:

In an electric railway, the combination with the slotted conduit, of a trolley mounted therein, and electrical connections extending from said trolley to the railway motor, and to the feeder within the conduit; said trolley frame having its edges turned down to make it a petticoated insulator.

Switches and Cut-Outs :—

Switch for Operating Shunt Wound Electric Motors, F. H. Berry, Milwaukee, Wis., 492,456. Filed March 3, 1892.

Has for its object to provide for operating the motor forward or backward at variable speed and power.

Ligtning Arrester, C. F. Scott, Pittsburgh, Pa., 492,544. Filed July 29, 1892.

Employs an inclosing box having electrodes projecting into it, contact plates within the box against which the electrodes rest, and lightning discharge plates between which are intermediate air gaps within the box and connected respectively with the plates.

Thermostatic Fuse Device, A. Wurts, Pittsburgh, Pa. 492,547. Filed Jan. 14, 1892.

Claim 1 follows:

The combination of two or more electrodes of non-arcing metal and a fusible strip connected in shunt upon and placed in close proximity to said electrodes.

Lightning Arrester, A. Wurts, Pittsburgh, Pa., 492,548. Filed March 12, 1892.

Claim 4 follows:

In a lightning arrester, confronting electrodes presenting to each other curved surfaces studded with numerous closely assembled points.

Lightning Arrester, A. Wurts, Pittsburgh, Pa., 492,549. Filed Aug. 29, 1892.

Employs lightning arresters in the generator circuit and an automatic circuit interrupting device for interrupting the arcs of the lightning arrester.

Lightning arrester, T. W. Wheatley, Wilkes Barre, Pa., 492,649. Filed Nov. 14, 1892.

Employs an explosion chamber connected with a switch lever and included in the main circuit.

Telegraphs :—

Relay, J. W. Lattig, Easton, Pa., 492,699, Filed Nov. 28, 1892.

Telephones and Apparatus :—

Long Distance Electric Telephony, C. M. Haynes, Omaha, Neb., 492,467 Filed Jan. 12, 1892.

System of Combined Telephony and Telegraphy, F. A. Pickernell, Newark, N. J., 492,471. Filed Apr. 29, 1892.

Relates to systems of combined telephony and telegraphy wherein the simultaneous transmission of telephonic and telegraphic signals over the same conductor is rendered possible.

Signalling Apparatus and Circuit, E. J. Hall. Morristown, and F. A. Pickernell, Newark, N. J. 492,482. Filed Oct. 13, 1892.

Relates to call generators for telephony exchanges, to their circuits and to devices for graduating, controlling, and differentiating their circuits.

Busy Signal for Telephone Circuits. E. J. Hall. Morristown, and F. A. Pickernell, Newark, N. J. 492,483. Filed Oct. 13, 1892.

Telephone Central Station Circuit, J. L. McQuarrie, Boston, Mass. 492,484. Filed Sept. 8, 1892.

Invention consists of means for rearranging the circuits of an old switchboard giving it all the advantages of a modern branch terminal switchboard and also in the elimination of a false busy test sometimes occurring in the boards now in use.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED MARCH 7, 1893.

Accumulators :—

Secondary Battery Electrode, I. H. Bartholomew, Northford, Conn., 493,007. Filed May 31, 1892.

Consist of a group of lead tubes inwardly upset and pierced from the outer side to make inwardly projecting points; these tubes containing the active material which is retained in position by the points and upsets.

Apparatus for Transferring Secondary Batteries, M. Pfatischer, Philadelphia, Pa., 493,221. Filed July 22, 1892.

An electrically operated movable charging table.

Alarms and Signals :—

Automatic Electric Sprinkler and Alarm, C. S. Hurd, Cleveland, O., 492,866 Filed April 13, 1892.

Hotel Time Annunciator, F. S. Carter, Burlington, N. J., 493,067. Filed Aug 15, 1892.

Electric Railroad Danger Signal and Bell, P. Seiler, San Francisco, Cal., 493,125. Filed July 13, 1892.

Designed to utilize the present construction of trolley wires, to operate danger signals in the shape of lights, bells, etc., to announce the approach of cars.

Dynamos and Motors :—

Dynamo Electric Machine and Motor, R. M. Hunter, Philadelphia, Pa. 492,888. Filed Oct. 29, 1892.

Employs an armature having two or more independent windings connected with independent commutators whereby the poles in the armature may be maintained intermediate of the poles of the field magnets.

Armature for Electric Motors, R. H. Hassler, Dayton, O., 493,025. Filed Aug. 15, 1892.

An armature having its magnetic material forming an annular band leaving an interior cylindrical cavity the entire length of the armature, and having coils placed in such a way that the interior cavity will be filled by the flanks of the coils, the latter passing in and out of the cavity at the same end of the armature.

Dynamo-Electric Machine, W. Mordey, London, Eng., 493,101. Filed Apr. 28, 1891.

Employs a laterally detachable armature coil, a pair of plates between which the outer end only of the coil is clamped and bolts extending through the plates and coil projecting laterally from one side and adapted to be secured to a supporting frame.

Frame for Electric Motors, A. W. Meston, St. Louis, Mo. Design, 22,277. Filed Aug. 30, 1892.

Lamps and Appurtenances :—

Adjustable Lamp Hanger, N. Jenkins, Waterbury, Conn., 492,808. Filed Apr. 19, 1890.

Incandescent Lamp, J. von der Kammer, Chicago, Ill., 492,809. Filed Jan. 23, 1893.

An incandescent lamp having a platinum base bearing projections which take the place of the leading-in wires; the base being adapted to be used over and over again when the lamp is broken. (See THE ELECTRICAL ENGINEER this issue page 281.)

Electric Arc Lamp, C. K. MacFadden, Chicago, Ill., 492,815. Filed Aug. 12, 1892.

Employs a solenoid with a movable core concentric with the lower carbon and a dashpot whose piston is attached directly to the movable core of the solenoid and concentric with the carbon and core.

Balanced Electric Drop Light Hanger, T. E. Stevens, Blair, Neb., 492,847 Filed June 21, 1892.

Incandescent Lamp Socket, J. F. McLaughlin, Phila., Pa., 493,109. Filed Sept. 13, 1892.

A regulating socket for incandescent lamps having an incomplete-carbon ring provided with an insulating portion projecting beyond the periphery of the ring and a brush bearing upon the ring in the path of the insulating block.

Miscellaneous :—

Electric Lamp Lighter, J. C. Chambers, Detroit, Mich., 492,913. Filed Nov. 21, 1892.

Game Apparatus, S. N. Johnson, Chicago, Ill., 492,961. Filed Apr. 19, 1891.

Electric Program Clock, A. J. Reams, Wichita, Kansas, 492,971. Filed Aug. 3, 1891.

Luminous Fountain, G. Trouvé, Paris, France, 492,999. Filed Sept. 14, 1892.

Electric Steering Gear, L. S. Van Duzer, U. S. Navy, 493,000. Filed Nov 26, 1892.

Employs an electromotive device for regulating the application of power to the tiller, a switch for regulating the direction of the applied power, and a steering lever having circuit connection with the switch for regulating its movements.

Combined Cigar Cutter and Electric Lighter, A. Huot, New York, N. Y., 493,030. Filed June 22, 1892.

Railways and Appliances :—

Electro-Magnetic Brake, A. D. Ayres, Kalamazoo, Mich., 492,773. Filed Dec. 21. 1891.

Apparatus for Automatically Stopping Railway Trains, E. W. Robinson, Boston, Mass., 493,837. Filed July 13, 1891.

Provides means for automatically stopping a moving train within a predetermined distance of another train or obstruction upon the track.

Leading Piece for Overhead Electric Railways, H. D. Winton, Wellesley. Mass., 492,881. Filed June 20, 1892.

Consists of independent leading pieces which can be strapped to a trolley wire so that they will clamp upon plates in such a manner that the trolley wheel will be directed from one wire to another.

Truck for Electric Locomotives, J. C. Henry, New York, N. Y., 493,089. Filed Dec. 18, 1891.

Claim 1 follows:

The combination with the car wheels and axles of the truck-frame, the motors supported thereon and the shouldered cross-bar forming part of said frame and spreading over said bars thereof against the wheel hubs.

Trolley Wire Support, F. E. Head, Toledo, Ohio, 493,212. Filed June 13, 1892.

Claim 1 follows:

The combination with a U-shaped hanger of a clamping piece arranged therein, and a collar or nut screwed upon the hanger and adapted to hold the clamping piece upon the wire.

Switches and Cut-Outs:—

Automatic Electric Switch, A. M. Coyle, Baltimore, Mo., 492,786. Filed Febr. 18, 1892.

An automatic switch in which the movement of the soft iron plunger of a solenoid carrying a contact brush and traveling over a series of fixed contact plates cuts out the resistances one after another.

Automatic Circuit Breaker, D. Irish & J. G. Williams, Salt Lake City, Utah, 492,807. Filed Sept. 14, 1892.

Employs an electromagnet in the working circuit, a weighted drop armature at one end of the magnet, a stationary contact in the magnet circuit and a movable spring supporting contact held normally away from the stationary contact and controlled by the drop armature.

Combined Indicating Electric Switch and Current Reverser, A. B. and W. S. Strowger, Chicago, Ill.., 492,850. Filed Feb. 19, 1892.

Claim 1 follows:

A combined indicating switch and current reverser consisting of an indicator, a series of pairs of contact heads, the heads of each pair being adapted to be connected with the opposite poles of a battery, and a switch movable over said heads and adapted to be brought into contact therewith and provided with means for reversing the current.

Automatic Switch, C. H. Bedell, Swarthmore, Pa., 493,009. Filed June 25, 1892.

A spring actuated double brake switch, normally held closed by the action of an electromagnet and automatically released by a lever actuated by said magnet.

Telephones and Apparatus:—

Speaking Telegraph, T. A. Edison, Menlo Park, N. J., 492,789. Filed Sept. 5, 1877.

Employs a transmitter, consisting of a vessel containing an electrolytic fluid for varying the resistance. (See The Electrical Engineer, this issue, page 283.)

Telephone Transmitter, C. T. Bloomer, New York, N. Y., 492,883. Filed Dec. 14, 1892.

Employs a variable resistance consisting of strips or ribbons of carbon surrounded by pulverized carbon and enclosed in an elastic case. (See The Electrical Engineer, this issue, page 281.)

"THE CLOUDED SKY IS NOW SERENE."

We have been requested to publish the subjoined curious document, which is a copy of a letter forwarded to branches of the N. B. E. W.

March 11, 1893.

Dear Friend & Brother:

We beg to advise you that we have this day settled our grievance with the N. Y. Insulated Wire Co., covering their contract on the construction work for the World's Columbian Exposition. Copy of this contract will be forwarded to you in a few days. You will therefore advise all your members that our grievance has been amicably settled and the disposition shown towards us by the New York Insulated Wire Co. in aiding us to adjust our differences with the Directors of the Columbian Exposition induces me to request that all objections you may have to the goods manufactured by the New York Insulated Wire Co. shall be removed at once, and on the contrary they should be recommended by you.

Fraternally yours,
Henry Miller, Grand Prest. Nat'l B. E. W.

NEW YORK NOTES.

The Delaware Hard Fibre Company, of Wilmington, Del., since the establishment of agencies in Great Britain, France and Germany, have had their business increased to such an extent that it is necessary their facilities be doubled. They are enlarging their plant by the addition of a brick extension at either end of their main building. One floor of the extension is to be used as an addition to the machine shop, and another floor for the rod making department. They have now the largest and most complete fibre plant in the world.

Messrs. J. C. Mortimer & Company have opened offices at room 227, Electrical Exchange Building, New York. They will act as manufacturers' agents and dealers in general electrical supplies. They will buy and sell apparatus, either new or second hand, rewind armatures, supply commutators, furnish carbon brushes and engage in general repair work. They invite communications from parties wishing estimates, or from those who have apparatus to sell.

Mr. Paul T. Kenny, who formerly represented the Mather Electric Company in New York, has, we are requested to state, entirely severed his connection with that concern and is not connected in any way with either the parent company or any of its branch offices.

Mr. W. D. Sargent, of the New York and New Jersey Telephone Company, has taken a well-earned rest as well as a much needed change by leaving last week for Florida. He will go first to St. Augustine, and will then make the Indian River trip.

Messrs. P. Claus & Company, manufacturers of the P. Claus Slow Speed Incandescent Dynamo, announce that increasing trade has forced them to enlarge their facilities. They have removed their office and factory from 357 West 40th street to 550–552 West 36th street, New York City, where they have 175 h. p. at their disposal, and are enabled to thoroughly test even the largest dynamos before they are shipped to customers.

Mr. Herbert Laws Webb sails for London on the 22nd inst., per White Star line *Majestic* on business for the Electric Selector & Signal Company. We learn that the foreign demand for that company's selective appliances is assuming considerable importance. The devices are now perfected and are capable of performing a great variety of most useful functions in lighting, telegraphy, motor work, etc.

"Micanite" For Germany. The Mica Insulator Company, of 218 Water street, report a large order for their new specialty from one of the most important electrical manufacturing establishments in Germany. There can be no question as to the interest taken in this article by builders of dynamos and motors, etc.

The Berlin Iron Bridge Company, of East Berlin, Conn., are at work putting up the roof trusses on the new light and power station for The Electric Light and Power Company, at Syracuse, N. Y.

NEW ENGLAND NOTES.

The North Shore Traction Co., of Lynn, Mass. have placed the contract for their new car shed with The Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 103 ft. in width and 300 ft. in length, constructed entirely of iron and brick in order to have the station fire-proof. The same company are also making an addition to a car shed for The Wilmington City Railway Co., at Wilmington, Del.

The Germania Electric Company, of Boston, have made an assignment to Mr. Charles A. Williams, 18 Post Office Square, Boston, and have now practically gone out of business. If arrangements can be made with the General Electric Company, the assignee will endeavor to dispose of the stock of lamps which they have on hand at Marlborough.

The Edison Electric Lighting Company, of Boston, are putting a fourth engine in their Central station. In the connections they are placing a six inch separator and a twelve inch grease extractor of the De Rycke pattern, the three engines now in use being already equipped with these well-known and reliable devices.

The Auburn Electric Motor Co. recently referred to in our columns, will have its headquarters at Auburn, Me. They are in the field as makers of electrical apparatus, and all information can be had by addressing W. F. Brown.

PHILADELPHIA NOTES.

The Phœnix Iron Works Company, of Meadville, Pa., report among their sales for March, the following Dick & Church tandem compound engines: Carnegie Steel Company, Limited, Pittsburgh, Pa., two condensing engines, of 150 h. p. each Gokey and Sons, Jamestown, N. Y., two non-condensing engines of 150 h. p. each; Trumbull Electric Railway Company, Warren, Ohio, one non-condensing engine of 150 h. p.; Salt Lake City, Utah Electric Light Company, one non-condensing engine of 115 h. p.

Mr. Milton F. Adams, of New York, gave an exhibition of the Edison phonograph at the Drexel Institute, on March 9, illustrating its practical use for commercial and social purposes, and for recording music, oratory, etc.

The Arnold Electric Manufacturing Company, of Chester, Pa., have been appointed agents for the Electric Manufacturing Company of Oconto, Wis., and will hereafter handle in the East, the "Brilliant" Incandescent Lamp manufactured by the Western concern.

Williamsport, Pa., has a new competing telephone exchange, fitted up by the Shaver Corporation of New York, with Shaver "duplex" apparatus, etc. This is understood to be the first non-Bell telephone exchange to get into operation.

J. W. Parker & Company, representatives of the Ball Engine Company, Erie, Pa., have lately installed a 100 h. p. Ball engine at the Bloomsburg Electric Light Company, Bloomsburg, Pa.

AWAITING A PURCHASER.

Mr. H. S. Byington, of the well-known Baltimore Business Agency, Telephone Building, Baltimore, is looking for a purchaser for the Wenstrom property, plant, etc., all of which is worth buying, and can be had for the sum of $175,000 to $200,000. It is a fine equipment, all ready for the manufacture of dynamos and motors on a large scale.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW APPARATUS OF THE GENERAL ELECTRIC COMPANY.

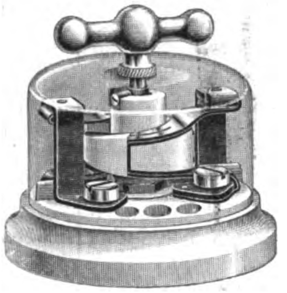


FIG. 5.—SNAP SWITCH.

THE GENERAL ELECTRIC COMPANY has just put upon the market a feeder switch of an entirely novel design, presenting a reversal of hitherto accepted practice, and one from which many objectionable features present in former types have been eliminated.

In the switch in question, instead of a blade descending jack-knife-wise, into receiving clips on a slate base, the solid contacts are rigidly mounted on the base, and the clips operated by the handle come down one on each side of the contact piece. The switch is so designed as to have all contact surfaces true, this being effected in one operation upon a machine especially devised for the purpose. The soldering of the clips into the lugs is done away with, the lug and contact pieces being one homogeneous piece. The parallel clips are hinged to one contact piece, and are also securely riveted to a piece of metal half way between the hinge and making end. To this piece is fastened the handle, which projects upward, and then forward at an angle of about 45 degrees as shown in Fig. 4.

The principal and most valuable characteristic of this switch is an almost perfect contact surface, having a low co-efficient of friction, with high conductivity, the two surfaces acting as if lubricated, minus the additional resistance of a lubricator. The split blade descending on the contact pieces, yields uniformly, and thus makes an ideal contact.

A new method of breaking the circuit, differing radically from all others hitherto adopted, has been introduced in this switch and no attempt has been made to bring the entire blade portion to a high velocity as in other instantaneous switches.

The device by means of which the circuit is thus suddenly broken is a genuine innovation. It consists of a short brass bar fastened on the under side of the switch blades, one end pivoted near the middle of the blades, and the other being held by a spiral spring, while on the side of the contact post facing the hinge of the switch is a small projection. As the switch is opened, the end of the small bar catches on this projection, and thus remains in full contact until after the blades have entirely left the contact post. When the switch is well opened, the bar slips off the contact post, and is drawn by the spring to its original position against the blades of the switch. By means of this ingenious device, a sudden break is obtained; and as the connection is unbroken until after the blades have left the contact piece, the contact surfaces of the switch do not suffer from arcing—two features of especial advantage in switches of this character. These switches are designed for use on circuits of a potential not exceeding 500 volts, and are made in capacities running from 80 to 1,500 amperes.

It has remained for the inventive talent at the command of the General Electric Company, to invent a system for controlling the distribution of the electrical current in buildings which does away with porcelain link or plug cut-outs, when used as distribution centres for a number of circuits.

Fig. 1. shows one of these panel distribution boards, arranged for the distribution of current for 120 lights, from a three wire main service over twelve circuits on a two-wire system. The panel itself is a polished white marble slab ten by twenty inches. The main wires are brought to the lugs, and are continued along the front of the panel in the shape of flat hard-drawn copper rods. Upon those are mounted stiff spring copper clips. Each main wire, and each side of each branch circuit is protected by a fuse enclosed in a porcelain box of novel design, from the sides of which project short, flat blades of copper, By means of these blades, the fuse carrier is inserted in position, and is there securely held by the copper clips. A perfect frictional contact is thus insured.

The construction of the fuse carrier, Fig. 2, is peculiar. It is literally a box with three sides straight, and one arched, having a partition in the centre, between the two terminals to which the fuse is fastened, as shown in the cut. When compared with the time-honored screw plug or ordinary fuse, its advantages are so obvious that practical men cannot fail to recognize and appreciate them. No short circuit can possibly occur between the terminals; the arc cannot follow the fused metal and burn them out; the molten metal cannot be blown out, the mica-lined cover preventing this. The area of contact is considerably greater than in the case of the screw fusible plug, and in replacing a blown fuse the wireman is not exposed to any danger from a sudden blowing of the new fuse. A fuse carrier can be removed and the fuse replaced on the spot; or, a fresh one can be inserted, and that in which the fuse has blown can be carried away and the fuse replaced in the repair shop. The removal of a fuse carrier, with fuse, of course, disconnects the circuits. The porcelain carriers are practically indestructible by the current. They are made from the best white vitreous porcelain, from the porcelain factory of the General Electric Company. The fuse carriers protecting the main wires, Fig. 3, are furnished with small brass rings to facilitate their removal; the smaller carriers are more easily drawn out, and the ring is unnecessary.

All connections are made upon the face of the panel. This disposition enables it to be fastened against a wall, or to be sunk in a recess bringing its surface flush with the wall, a glass door hinged to a polished wooden frame, serving to protect it from the inquisitive.

This style of panel distribution board can be made up in almost any combination of circuits, and can be placed almost anywhere in any building, its handsome appearance detracting in no wise from any surrounding decoration. The new Waldorf Hotel in this city is the first building to be equipped with these panels, no less than 3,500 lights being distributed from a number of them.

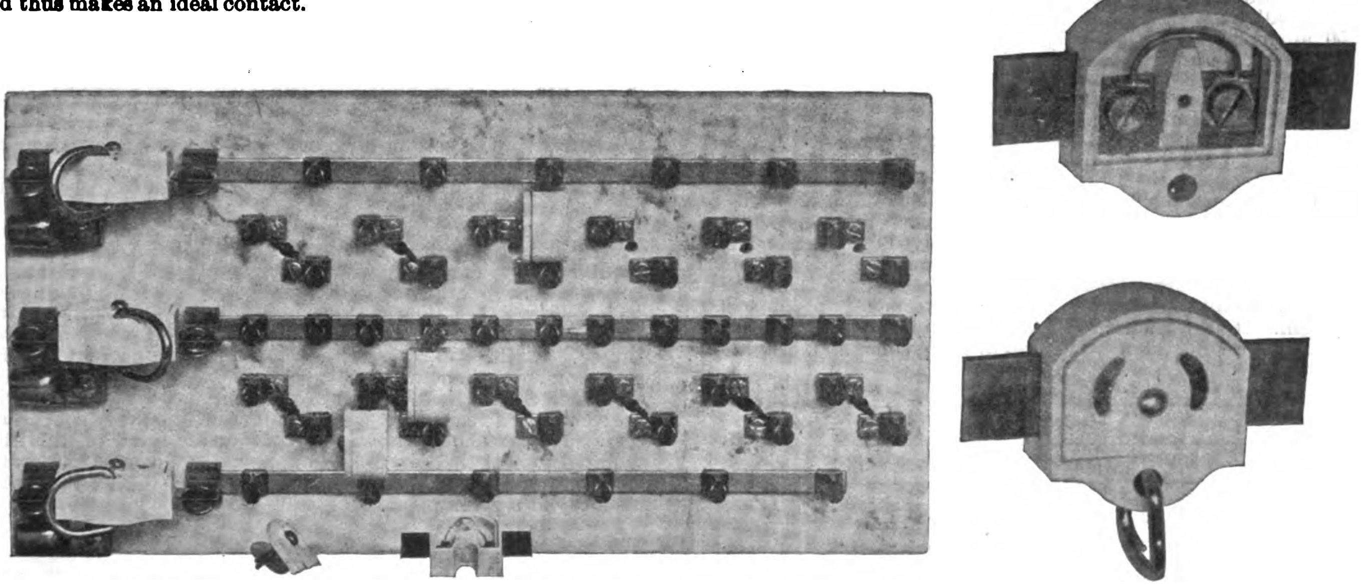


FIG. 1, 2 AND 3.—GENERAL ELECTRIC DISTRIBUTION BOARD AND FUSE CARRIER.

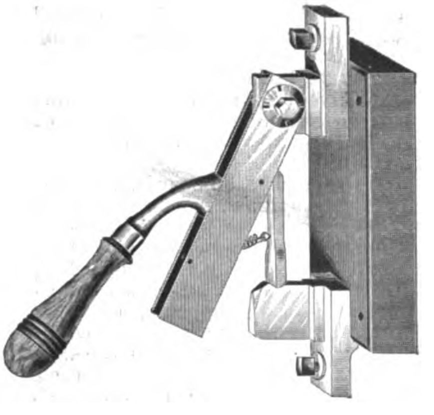


FIG. 4.—FEEDER SWITCH.

The next illustration, Fig. 5, shows a snap-switch of entirely new design, which owes its creation to the General Electric Company. The characteristic and distinguishing feature is the ratchet piece, which has four steps arranged in quadrants on both the upper and lower sides and revolves horizontally, two large and two small. One of these ratchet steps is covered with a copper strip passing across the porcelain to the corresponding step on the other side of the ratchet block. Two contact strips of hard spring copper, placed opposite to each other top and bottom on either side, bear upon the copper pieces on the ratchet when the circuit is completed. When the ratchet is revolved, the copper spring pieces are slowly forced apart until the crest of the steps is reached, when they spring to the uncovered steps or quadrants instantaneously, rendering arcing impossible, and placing between them a barrier of porcelain insulation. A similar forward movement instantaneously makes the circuit. The arrangement is similar to that in the ordinary plug switch in which a solid mass of metal is inserted between contacts, and the circuit broken by its removal. In this switch the metal plug is withdrawn and instantaneously replaced by a porcelain plug. By the peculiar formation of the ratchet and the length of the copper brushes it has been found that the latter do not acquire a permanent set, even after long use. These switches are made in the double pole variety only, and are of the two patterns—the ordinary type, and the flush-pocket style. The latter is adapted to insertion in wall pockets, and is then furnished with a decorative wall plate. They are designed in capacities of 10, 25, 40 and 50 amperes. For simplicity of mechanism and certainty of operation, this switch carries with it its own recommendation.

FUSE WIRE AND ITS USE.

THE above is the title of a pamphlet recently issued by the Shawmut Fuse Wire Company, of Boston, containing some very valuable information, and diagrams, two of which we reproduce.

The proper use of fuse wire has received comparatively little attention, not only from those who actually use it, but from the engineers who are supposed to specify the correct methods of employing all the various devices that make up an electric system. It is perhaps a small matter in itself, yet a fuse is considered necessary as a protection to the system, and, as with any device meant to protect, it should receive proper attention, or it only increases the danger by giving a confidence that is not warranted.

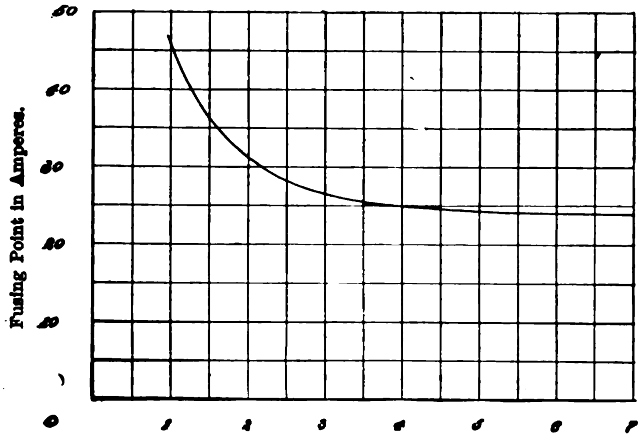


FIG. 1.—LENGTH OF FUSE IN INCHES.

The great trouble is that fuse wire is not always used so that it does limit the demand put upon the apparatus. This is largely due to the fact that "fifty ampere wire" is not always "fifty ampere wire," be it the most perfect in the world; and all because the fuse blows only when it is sufficiently heated, and anything that prevents this heating prevents the fusing. Every one knows the difficulty there would be in soldering the end of a wire to a copper brick. It is not realized, however, that there is, in varying degrees, this escape of the heat to the brass or copper terminals of a fuse block. The very accumulation of heat required to make the fuse act, is often prevented by using such short fuses that an abnormal current is necessary to produce the heat faster than it can be conducted away. This action is shown by the diagram, Fig. 1. If wire of any given size is tested in different length pieces, and the fusing points are plotted with lengths of fuse as abscissæ and fusing points as ordinates, a curve drawn through the plotted points will be similar to that shown.

It will be noticed that for lengths above three inches in this case, the fusing point is practically constant, while in very short lengths the fusing point rises rapidly, owing to the conduction of the heat from the fuse by the terminals or binding screws. This conducting away of the heat depends very largely on the size of the terminal blocks, so it is evidently advisable to use this wire in a three inch length at least. It is then beyond the point where disturbing influences have serious effect.

Time also comes in as an important factor in some cases, and the curve shown in Fig. 2 will give an idea of the relation between the current and the time such current takes to heat a given fuse to melting point.

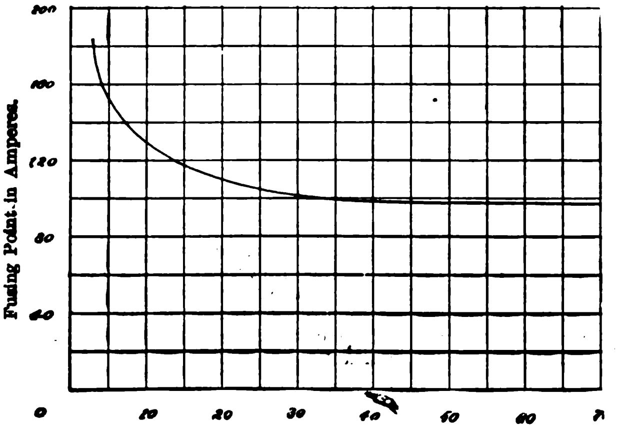


FIG. 2.—TIME REQUIRED FOR FUSING, IN SECONDS.

A number of fuses, exactly alike, were tested in the same cut-out, but fused with different strengths of current. The fuses in all cases first carried 75 amperes for five minutes. The current was then increased to the fusing point selected, and the time required for fusing was carefully noted. It will be seen that the curve becomes almost parallel to a line representing 96 amperes, which shows that this is the "ultimate fusing point," or the smallest current that would cause fusing, however long it continued. It will also be noticed, however, that a current only five per cent. higher blew the fuse in 30 seconds. As the time decreases, the current necessary to fuse increases rapidly, showing the ability of a fuse to stand sudden increases of very short duration. It also shows, however, that on account of this time required to heat the fuse to melting point, one cannot expect it to do the work of an automatic cut-out, which opens the circuit instantly at a given point.

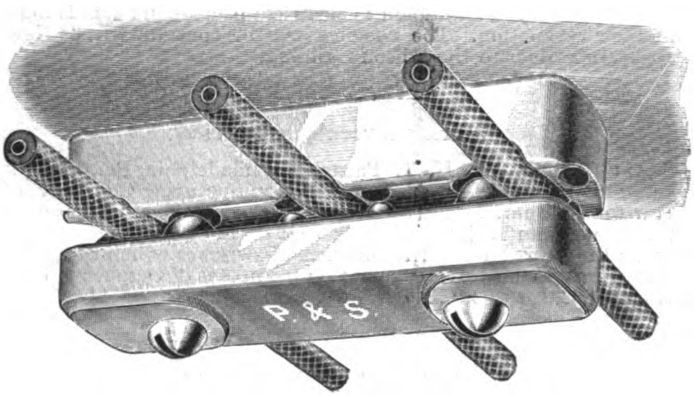
BALL ENGINES SALES.

THE BALL ENGINE COMPANY, Erie, Pa., have made some unusually large shipments for this time of year, and report that they are crowded with orders. The following are some of their recent shipments:

L. M. Rumsey Manufacturing Company, St. Louis, Mo., two 35 h. p. engines Midvale Steel Company, Nicetown, Pa., one 180 h. p. engine; General Electric Company, Tucson, Arizona, one 130 h. p. engine: Lakewood Casino Company, Lakewood, N. J., one 50 h. p. steam plant; Calumet Street Railway Company, Chicago, four 300 h. p. cross compounds; Wheeling Street Railway Company, Wheeling, W. Va., three 250 h. p. cross compounds; Western Light & Power Company, Chicago, one 300 h. p. engine; Risdon Iron Works, San Francisco, three 150 h. p. tandem engines; Cienfuegos, Cuba, one 60 h. p. engine; Nantasket Steamboat Company, Boston, three 25 h. p. engines, and one 35 h. p. engine; Griggsville Electric Company, Griggsville, Ill., one 50 h. p. steam plant; Frank Jones Building, Cincinnati, Ohio, one 35 h. p. engine; Hahne & Company, Newark, N. J., one 35 h. p. engine; Hammond Electric Railway Company, Hammond, Ind., one 150 h. p. steam plant; Logansport Electric Light Company, Logansport, Ind., one 180 h. p. engine; Combination Mining & Milling Company, Philipsburg, Mont., two 35 h. p. engines; Doylestown Electric Light Company, Doylestown, Pa., one 100 h. p. engine; Macon & Indian Springs Railway Company, Macon, Ga., one 150 h. p. steam plant; Dayton Manufacturing Company, Dayton,, O,, one 100 h. p. engine; Cooley & Vater, Duluth, Minn., one 80 h. p engine; Seabury & Johnson, East Orange, N. J., one 25 h. p. engine; Produce Exchange, New York City, one 25 h. p. engine; Edison Electric Illuminating Company, Mt. Carmel, Pa., one 100 h. p. engine.

THE PASS & SEYMOUR THREE-WIRE CLEAT.

The accompanying illustration shows a new three-wire cleat recently introduced by Messrs. Pass & Seymour, of Syracuse, N. Y. This is a modification of the two-wire cleat, already described in these pages, and has become very popular with construction companies and also with the wiremen.

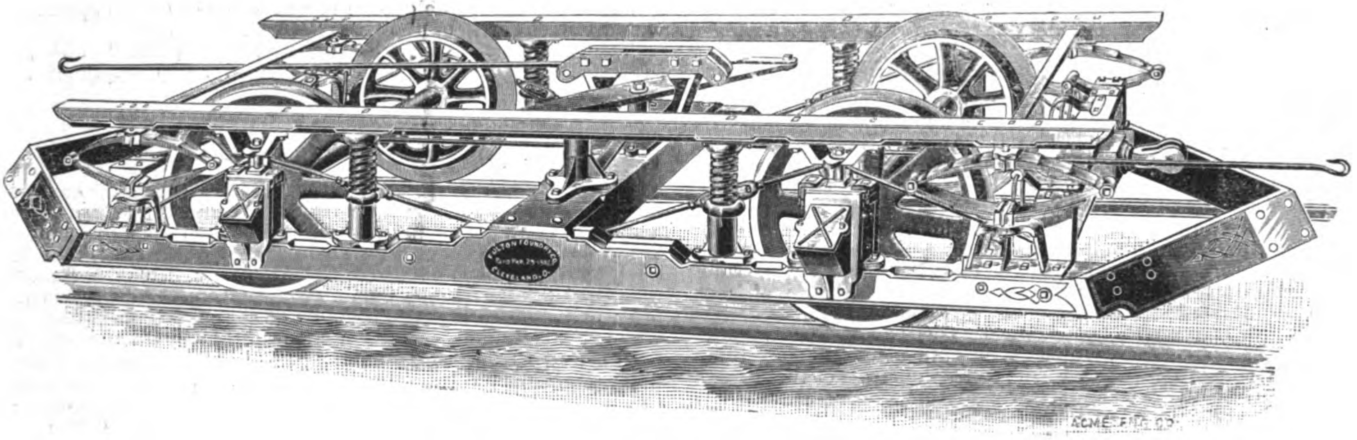


The Pass & Seymour Three-Wire Cleat.

It is made of the best glazed Syracuse china, and is applicable to the best installations on the three-wire system.

THE FULTON TRUCK.

The Fulton Foundry Company, of 202 Merwin street, Cleveland, Ohio, the well-known makers of car wheels, motor trucks, railway castings, rails, etc., are crowded to the fullest capacity of their factory to fill the orders which have been coming in of late, many of which are for electric railway work.


FULTON FOUNDRY
CLEVELAND, O.
ACME ENG. CO.

The Fulton Street Railway Truck.

The accompanying illustration shows their electric truck No. 1 A, which is in great demand at present and is used extensively on the East Cleveland R. R. Company's lines. As will be seen, the truck is designed with a view to lightness and strength combined, and is one of the most successful in use for street railway work.

The car body is supported upon a special frame provided, in addition to the ordinary helical springs, with eliptical springs at the ends. This prevents any disagreeable "teeter" and adds greatly to the comfort of the passengers.

NOT SAD IRONS BUT GLAD IRONS.

Just at this season of the year when it is not quite cold enough to keep up furnace or stove fires, the electric radiators and heating apparatus sold by The Ansonia Electric Company, (formerly The Electrical Supply Co.) cor. Randolph street and Michigan avenue, Chicago, come in as a very happy and convenient substitute for those having electric current available.

The Ansonia Electric Company is in receipt of the following letter from one of its many delighted customers:

"Answering your letter of the 3d inst., I beg to say that my wife objected very strongly to using one of your sad irons when I purchased one first, but now she will use it in preference to the old style and would not be without one.

Let me further say that I am using one of your disc heaters, and am more than pleased with it. The City Marshal and myself eat lunch together, and on this one disc heater we cook beefsteak or eggs, boil coffee, potatoes, fry ham or anything we want for our midnight lunch.

After persons have once used these articles they cannot do without them any more than they can without the electric light."

Very truly,
(Signed) Chas. H. Fuller,
Engineer.

THE DE RYCKE SEPARATOR IN ELECTRIC LIGHT STATIONS.

That the De Rycke steam separator, which we described in a recent issue, is meeting with favor among central station managers in manifest from the following unsolicited letter:

Joseph De Rycke, Esq.,

Dear Sir:—We are surprised at the result obtained by the use of the No. 6 separator you sold to the "Peabody Electric Light Department." We are using a 17 x 36 inch Greene improved engine; all steam pipes are covered to prevent condensation. Indicator cards from engine showed some water. We put on a separator and found the water accumulating so fast that we decided to attach a trap to the drip. This has been done with satisfactory results. The engineer reports a saving of 150 pounds of coal in 13 hours run.

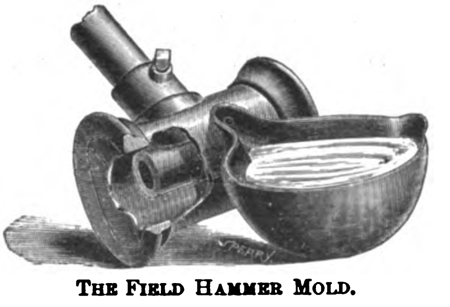
Yours truly,
Herbert Reed,
Chairman Electric Light Committee, of Peabody, Mass.

The above would indicate a saving of 24 gross tons of coal per year, an item well worth considering.

THE FIELD HAMMER MOLD.

The combination mold and ladle for casting soft metal hammer heads, shown in the accompanying illustration, is the invention of Mr. Charles H. Field, of Providence, R. I.

The location of ladle on the mold is such that, by simply depressing the handle from the position shown to a horizontal position, all the metal in the ladle will flow into the mold and surround the end of the handle. This can be done without its being taken from the fire. The handle consists of a piece of gas pipe with a T on the end, and it forms the handle to both mold and ladle while the metal is being melted and also the handle of the completed hammer. There is no liability of the head of this hammer being jarred off, and the head after becoming shapeless can be remelted in the same ladle and run on to duplicate handles. The ladle has a lip on the side admitting of its being used for an ordinary ladle.



The Field Hammer Mold.

The simplicity of this combination is such that it recommends itself to any mechanic without any long description or comments.

SALAMANDER WIRE.

In the issue of The Electrical Engineer of September 28, 1892, appeared an account of a comparative test of the "Salamander" wire, manufactured by the Washburn & Moen Co., of Worcester, Mass. This test, it will be remembered, resulted in the utter destruction of the covering of three other makes of wire, while that of the "Salamander" was quite unaltered in appearance.

A series of tests has recently been made by the Massachusetts Electrical Engineering Company which shows a remarkably high percentage conductivity increasing with the current. The wire has been subjected to a pressure of 15,000 volts without suffering deterioration and the insulation was not penetrated.

A three-minute electrification each day on cables 210 feet long immersed in water and in lime respectively, showed a uniform insulation resistance of 110,000 megohms. An E. M. F. of 550 volts was used on the cable in the water and 580 on the other.

The company have just issued a circular giving these tests and other information concerning their wires.

On February 16th some interesting comparative tests were made at the Worcester Polytechnic Institute, Department of Physics and Electrical Engineering, Worcester, Mass., using samples of Salamander lamp cord, manufactured by the Washburn & Moen Manufacturing Company, and samples of other makes of so-called fire-proof lamp cord. The tests were conducted in the following manner:

Six inches of Salamander double cord was joined in series with the same length of two other makes. A current of 36 amperes was then turned on and left for some minutes. The Salamander cord was not effected, while the other makes were first charred, then took fire, and burned wholly off, leaving the bare wire a dull red. The current was then increased to 41 amperes, which heated the bare wire of the other makes to a very bright red. This test lasted for about seven minutes. On cutting open the insulation of the Salamander cord after the test, the white cotton was found uninjured by the heat, the fire-proof covering continuous and the gutta percha apparently unchanged.

At any time during the test, the Salamander could be held in the hand without inconvenience from the heat.

ELECTRICITY IN WORLD'S FAIR HOTELS.

The crop of World's Fair Hotels affords a fine harvest for all departments of the building trades, which includes of course electrical devices. In this direction the Ansonia Electric Co. (formerly the Electrical Supply Company), corner Michigan avenue and Randolph street, seems to be holding its own. This company does no construction work itself and is therefore handicapped when it comes to bidding on complete jobs, but it has recently sold the entire electrical apparatus for some of the largest hotels now being built for the accommodation of World's Fair visitors. One of their latest orders is for a 250 number Ansonia gravity needle annunciator. Some of the largest and finest hotels in this city are now running all of their electric bells and alarms with the Diamond carbon battery, which is manufactured exclusively by the same company. They report that their sale of the Eureka bell, both iron and wood-box, is rapidly increasing, although it seemed to have reached the "high water mark" some time ago. This shows what can be done by manufacturing a thoroughly good bell and placing it on the market in such quantities as will enable it to be sold at a reasonable price.

THE BERLIN IRON BRIDGE COMPANY.

The Berlin Iron Bridge Company, of East Berlin, Conn., have secured the contract for the new buildings required by Wm. Cramp & Sons, Ship and Engine Building Company, Philadelphia, Penn. The Berlin Iron Bridge Company have lately completed a boiler shop for the Cramps, and now have a contract for all their other buildings required to enlarge their plant. The new buildings will consist of a ship shed, 60 feet by 100 feet, a black board 75 feet by 200 feet, and a bending shed 86 feet by 150 feet, constructed throughout of iron.

The Berlin Iron Bridge Company have also just completed a power station 38 feet wide by 112 feet long, for The Roaring Fork Electric Light and Power Company, at Aspen, Colo.

THE J. T. CASE ENGINE COMPANY

of New Britain, Conn., have issued a very tasteful little folder descriptive of their automatic, high speed engines. These engines have become very popular of late, especially where economy of space is desirable and among the other advantages claimed for them are simplicity, compactness, lightness of moving parts, large wearing surfaces, direct action, automatic lubrication, perfect regulation, and interchangeability of parts.

The folder is artistic in design, concise in arrangement and is from the press of Messrs. Bartlett & Co.

ALFRED DE CORDOVA & CO.

The copartnership heretofore existing under the firm name of Alfred de Cordova & Co., comprising Alfred de Cordova and John B. Dunham, has been dissolved, the latter retiring, and Eustace de Cordova has been taken into the firm. The new member is a brother of the principal, and has long had charge of much of its important work. The house is one of the foremost in Wall street, and has always made a specialty, among others, of Western Union stock. It is thus well-known to electrical people, and stands high in their estimation. The business will be continued at 36 New street, next door to the Edison Building.

ELECTRIC SWITCH LITIGATION.

On Feb. 10, Mr. H. T. Paiste, of Philadelphia, Pa., brought suit against the Hart & Hegeman Manufacturing Company, of Hartford, Conn., in the United States Circuit Court in that city, for damages and injunction to prevent them from manufacturing and selling certain eccentric movement switches which the plaintiff claims to be infringements on his patent of October 4, 1892, No. 483,892, for this "Xntric" switch movement.

DETROIT ELECTRICAL WORKS.

The Detroit Electrical Works, Detroit, Michigan, have recently added to their machine shop two 10-ton traveling cranes and one 15 ton jib crane. These cranes were recently successfully tested with loads 50 per cent. in excess of their rated capacity. They were manufactured and erected, together with the traveling crane tracks and supports, by the Detroit Foundry Equipment Company, Detroit, Michigan.

A NEW CUTTER CATALOGUE.

George Cutter, of Chicago, has issued another conveniently arranged catalogue of a chosen few of those electrical appliances which have come to be known as "Cutter Specialties."

The pamphlet contains 96 pages, clearly printed and profusely illustrated, the cuts being so placed as to be quickly and readily found.

THE CENTRAL ELECTRIC COMPANY.

The Central Electric Company, of Chicago, have just placed upon the market a hard rubber hydrometer, which is pronounced to be vastly superior to the old form of glass hydrometer. The Central Electric Company desire to advise the trade that they have for distribution monthly, *The Architects' Electrical Bulletin*, published by the Interior Conduit & Insulation Company, giving a brief description of the principal buildings in the country, in which the complete system of Conduiting and Okonite wire has been placed during the previous month, and containing many notes of interest on insulation and wiring. They will be pleased to mail one of these copies to anyone sending their card and will place them upon the regular list and forward them a copy of the bulletin each month free of charge. This will no doubt prove of interest and profit to contractors and central station men, as the Interior Conduit Company is constantly putting new and improved devices upon the market.

JENNEY ELECTRIC MOTOR CO.

The Jenney Electric Motor Company of Indianapolis has changed its Chicago office to 932 Monadnock Building, and will be glad to have all its Chicago and Western friends make a call there.

MONTREAL NOTES.

Mr. T. W. Sprague, of the Thomson-Van Depoele Electric Mining Co., of Boston, spent several days in this city during the conventions of the American Institute of Mining Engineers and of the Mining Societies of Nova Scotia and Quebec, which were held at the same time.

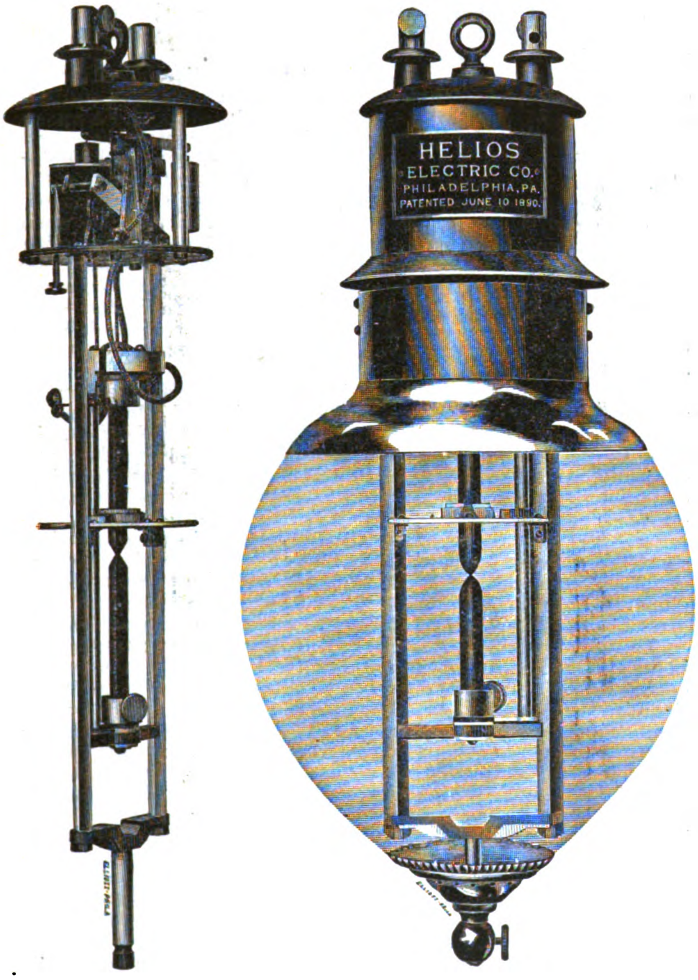
Mr. W. H. Brenner, electrical engineer of the Montreal Street Railway Co., has returned from a visit to New York and Boston where he had gone to examine the local power houses. It is the intention of the Montreal Co., to erect a power house this spring which will be second to no other in point of equipment.

Mr. F. H. Badger, Jr., of Montreal, was married on February 28, in that city to Miss Eliza Price. Mr. Badger has the congratulations and best wishes of the large number of friends he has made during his long association with electrical industries in Canada.

THE HELIOS ALTERNATING CURRENT ARC LAMP.

The Helios Electric Company, of 1,310 Filbert street, Philadelphia, have issued a 24-page catalogue of the Helios arc lamp, for the manufacture of which in this country they are the sole licensees. The description is concise and clear and the catalogue is well illustrated by engravings and diagrams.

The Helios arc lamp is the ingenious invention of Mr. Carl Coerper, of Ehrenfeld, Germany, with some minor improvements made by the Helios company, and is exclusively controlled in America by the Helios Electric Company of Pennsylvania. Fig. 1 shows the lamp with globe and cap removed. The construction and operation involve the most simple mechanism. As will be seen, the lower carbon holder is attached to a chain which is carried over a pulley in the lamp mechanism, the other end being attached to the upper carbon holder. The result of this arrangement is, that as the lower carbon ascends, the upper carbon descends, and exactly in the same ratio. The arc is thus fixed at a given point and remains stationary from the time the current is turned on until the carbons are consumed.



Figs. 1 and 2.—Helios Alternating Arc Lamp.

As is well known, the alternating arc forms a crater both in the upper and lower carbon, so that considerable light is emitted by the crater of the lower carbon, which is thrown upward and thus generally wasted. This has been overcome by placing, about one-half an inch above the arc, a white enameled reflector, which throws down all the light emitted from the lower carbon, increasing the illuminating power at least 40 per cent.

The regulation is effected entirely by a single solenoid coil, the feed of the carbon being controlled by a lever which presses against the periphery of a friction wheel included in the releasing train. By this means a feed of $\frac{1}{1000}$ of an inch is made possible. The upper carbon holder is made so as to slightly overbalance the lower carbon holder. The result is that the work of the solenoid coil and mechanism is restricted simply to the small weight representing the difference between the carbon holders. A free piston air dash pot serves to steady the movement of the regulating mechanism.

Fig. 2 shows the 7-hour lamp complete, with globe, ready for use. The length of the 7-hour lamp is 25½ inches over all; the 12-hour lamp, 32 inches. The single carbon principle is used exclusively, thereby avoiding the awkward complication found in double carbon lamps. In its manufacture economy in point of mechanical skill and raw material has been a secondary consideration. It may be mentioned that in Europe already over 30,000 of these Helios arc lamps are in daily use.

THE WESTERN LATCHSTRING HANGS OUT.

We have received from the Ansonia Electric Company a circular letter which seems to add still another distinguishing feature to an already roseate career of successful business. This letter informs us that:

> "Desiring to take advantage of the opportunity offered by the World's Fair to evidence our appreciation of favors in the past received in such abundance from our customers and friends, and realizing that the demands of our business are such as to make it impossible for those actually engaged in its every-day transactions to extend to our customers and friends such courtesies as we should be pleased to have them receive from us, we beg to announce that for this and other purposes in connection with the Great Exposition, we have organized a separate department or
>
> WORLD'S FAIR BUREAU,
>
> and have concluded arrangements to place this department in charge of Hon. Geo. B. Shaw, who has been recently elected to Congress, and is well known in electrical circles through his former connection with the National Electric Manufacturing Company, as its general manager.
>
> It will be a pleasure to us to hear from our friends, and to render them any possible assistance either before or during their visit to the Fair.
>
> Trusting that we shall find that we may be of service to them, we remain,
>
> Very cordially,
> THE ANSONIA ELECTRIC CO.,
> F. S. Terry, Manager."

We understand from a personal letter that the aim of the bureau established by The Ansonia Electric Co. is to provide a resort for their customers and friends, and it is intended that it shall embrace all of these features that will make the wayfarer feel perfectly at home. An entire floor of their large building on the corner of Randolph street and Michigan avenue has been given over to this purpose, and will be turned into reception parlors, reading and smoking-rooms, dressing-rooms and lavatories for ladies and gentlemen. Polite attendants will be in charge constantly, giving every attention to callers, and striving to make them feel that they have landed among friends instead of foreigners. Telephones, stenographers, writing desks, etc., will be at the service of callers, and a bureau of information will enable guests to plan their intermural travels without loss of time or vexatious inquiries of people no better informed than themselves. Here in the restful quiet of private rooms one may secure his theatre or lecture tickets, arrange for his accommodation at hotels, have his baggage checked, secure railway or sleeping car reserves, and in fine, have time to get his bearings and avoid a sea of trouble. Mr. Shaw will have his private office there, where he will be pleased to meet his many friends, as well as those of the Ansonia Electric Company.

If this isn't true Western hospitality, we don't know what to call it. It is evidently a sample of Chicago genius, and if everybody's aunts and uncles and cousins, and their sisters and brothers are to be looked after in the same generous and thoughtful spirit, we think there will be implanted in the hearts of all America, a loving remembrance of that city erroneously yclept "windy."

THE SAWYER-MAN ELECTRIC COMPANY.

A curious and annoying mistake created quite a little flutter in electrical circles last week. It was announced that the Sawyer-Man Company was about to wind up its affairs and had applied for permission to liquidate. This was understood to be the Sawyer-Man Electric Company, but it appears that the application was made by the old Sawyer-Man Illuminating Company of this city. It therefore affords us much pleasure to know and announce that the Sawyer-Man Electric Company, the parent organization, has no intention whatever of quitting but will pursue the even tenor of its way. Its many friends will wish it long life, and larger prosperity every year.

"THE ELECTRICIAN DIRECTORY."

This handsome publication has just reached us from the office of our excellent London contemporary. It is the eleventh year of issue, and has grown into a magnificent volume of 1,000 closely printed well arranged pages. We could heartily wish that the pretentious American book in this line were half as accurate, well compiled, and properly arranged.

A "LIGHTNING" ALBUM.

Our English contemporary "*Lightning*" which has done some very original and effective things, adds to the list of its novelties by publishing a New Year Album, in which it presents in a pleasing, picturesque, pictorial, pungent and persuasive way its usefulness, as an educator of the public on all electrical subjects.

The American Electric Elevator Co., R. A. Hewitt, secretary and treasurer, has removed to the Edison Building, 44 Broad street.

THE ST. LOUIS ELECTRICAL EXCHANGE.

THE ST. LOUIS ELECTRICAL EXCHANGE was organized about 18 months ago and is an incorporated institution. Its membership is composed of all the responsible construction firms, supply houses, light and power companies, fixturemen and others. The objects of the Exchange are as set forth in Article II. of their constitution, which reads as follows :

> The Exchange is organized for scientific and social purposes, and has for its special objects the advancement of the trade in all the latest discoveries of science appertaining to the practical introduction of the latest improvements in the electric art. To promote and combine the intelligence and influence of members for the protection of the trade against imposition, injustice or encroachments upon our common rights and interests ; encouraging inventions and improvements appertaining to the electrical business, fostering an interchange of thought, and eliciting and communicating for the benefit of each member, the best talent and the result of the experience and ability of all; to promote amicable relations with employees on the basis of mutual interest and equitable justice to both employer and employees, to encourage national and state legislation for the furtherance of the interest of electrical business ; to secure for the members of the trade equitable treatment in their dealings with manufacturers and dealers in supplies ; to regulate the system of apprenticeship and employment so as to prevent as far as practicable the evils growing out of deficient training in the discharge of responsible duties ; to create and maintain a standard code at as high a standard as the progress of practical science teaches ; and we agree to carry forward with tireless zeal, the great work to which the above language relates.

FLORAL TROPHY PRESENTED TO MR. TESLA BY THE ST. LOUIS ELECTRICAL EXCHANGE.

They are working in harmony with the underwriters, light companies and the Superintendent of City Lighting.

They have regular meetings twice a month where such subjects as relate to their business are discussed. The officers of the Exchange for 1893 are: Ed. T. Cook, president ; J. Masson, vice-president; Otto Kuhn, secretary; John Holdsworth, treasurer; and G. Brownlee, sergeant-at-arms. The Exchange has had a good influence on account of bringing together in close business relation the various construction companies in St. Louis.

The secretary, Mr. Otto Kuhn, would be pleased to hear from some of the leading firms in all the large cities in regard to organizing exchanges throughout the country. This would ultimately lead to forming a national association, which, no doubt, would be of large benefit to construction men throughout the country.

The secretary, on application, will forward a copy of their constitution and by-laws and will be pleased to give such other information as he may possess in regard to the workings of the Exchange. All communications should be addressed to 807 Market street, St. Louis, Mo.

By way of giving an idea of the public spirit pervading the body, we show here the beautiful floral trophy placed by the Exchange on the stage, at the Exposition Building, to grace the occasion of Mr. Tesla's lecture, and as a mark of honor to that gentleman. The trophy stood about four feet high, and was illuminated by incandescent lights, and was worked out in palm leaves, white and red carnations, and American Beauty roses.

THE HAVEMEYER BUILDING LIGHTING PLANT.

THE electric lighting plant of the Havemeyer Building in this city, which has recently gone into operation, contains the most recent developments in incandescent electric lighting for isolated plants. The plant is one of 3,000 lights. There are four McIntosh & Seymour engines, and four Eickemeyer dynamos. Three of the engines are of 65 h. p., and directly coupled upon the shaft of each of these engines is a dynamo of 40 kilowatts, while the fourth is 20 h. p. connected by an entirely new, and very interesting rope drive to a dynamo of 12 KW. This small engine and dynamo is for use during periods of light load. The switchboard is of polished, jet black, marbleized slate, and mounted on this are the voltmeters, amperemeters, main line switch, rheostats, ground detector and multiple switch for reading the E. M. F. at various points in the building.

The rheostats are those of the Carpenter Enamel Rheostat Company, which present a very handsome appearance, and occupy a surprisingly small space. The voltmeters and amperemeters are those of the Weston illuminated dial instruments, and were made especially for the contractors for use in this particular plant. There are two voltmeters and five amperemeters, one of the latter being in the circuit of each dynamo, and one reading the entire out-put of the plant. There are fourteen Ajax switches upon the switchboard, one for connecting the entire building upon the mains of the three-wire central station of the Edison company; one for each dynamo; eight for the office lights of the various floors, and one for the hall lights. The wiring of the building is done with metal-covered interior conduit throughout, the wire used being that of the Habirshaw Company, while Edison cut-outs and incandescent lamps are used.

The entire plant was installed by Messrs. H. Ward Leonard & Co., of 136 Liberty street, under the supervision of Mr. Frank A. Pattison, the consulting electrical engineer of the architect, Mr. Geo. B. Post. Promptly upon completion the entire plant was subjected to an exhaustive two-day test by Mr. Pattison. The dynamos were subjected to a full-load test of ten hours, and operated very perfectly in every way, the rise in temperature being only 100° Fah., while indicator diagrams from the various engines showed a very perfect steam distribution, and very close governing. The insulation of the system of conductors was 160,000 ohms, with everything in circuit. The plant was immediately passed by the Fire Underwriters, and accepted by the owners.

This plant is the first of its type in this country ; that is, one in which bipolar dynamos are directly connected to standard engines running at 275 revolutions per minute, and the exceptionally satisfactory results obtained reflect the greatest credit upon the contractors, to whom the selection of the particular apparatus to be used was left by the architect. The extremely small space occupied by the plant and the entire freedom from all noise and vibration make it highly probable that plants of this nature will soon become very popular for buildings of this description. The apparatus used in the present plant was supplied by ten different manufacturing companies, no one of whom was a bidder for the plant. This is a striking instance of the advantage held by a bulk electrical contractor, who is able to select and combine apparatus from the various manufacturing companies, so as to obtain the best result possible in every way.

It is a matter of interest to note that the floor space occupied by the entire plant, including the space between the dynamos and and surrounding them, is only five square feet per kilowatt.

GRAPHITE AT THE WORLD'S FAIR.

THE JOSEPH DIXON CRUCIBLE COMPANY, has at last been awarded space in the Columbian Exposition—a space 25 x 28 feet in the Mines Building for a general exhibit of graphite productions such as crucibles, lubricating graphite, graphite axle grease, plumbago facings, graphite machine and railway grease, Dixon's stove polish, silica-graphite paint, core wash, electrotyping graphite, graphite cylinder oil, graphite specialities for electrical and other work, etc.

A space of 13 x 10 feet only was obtainable in the Manufacturers' Building for an exhibit of Dixon's "American Graphite" pencils and pencil sundries.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XV. MARCH 29, 1893. No. 256.

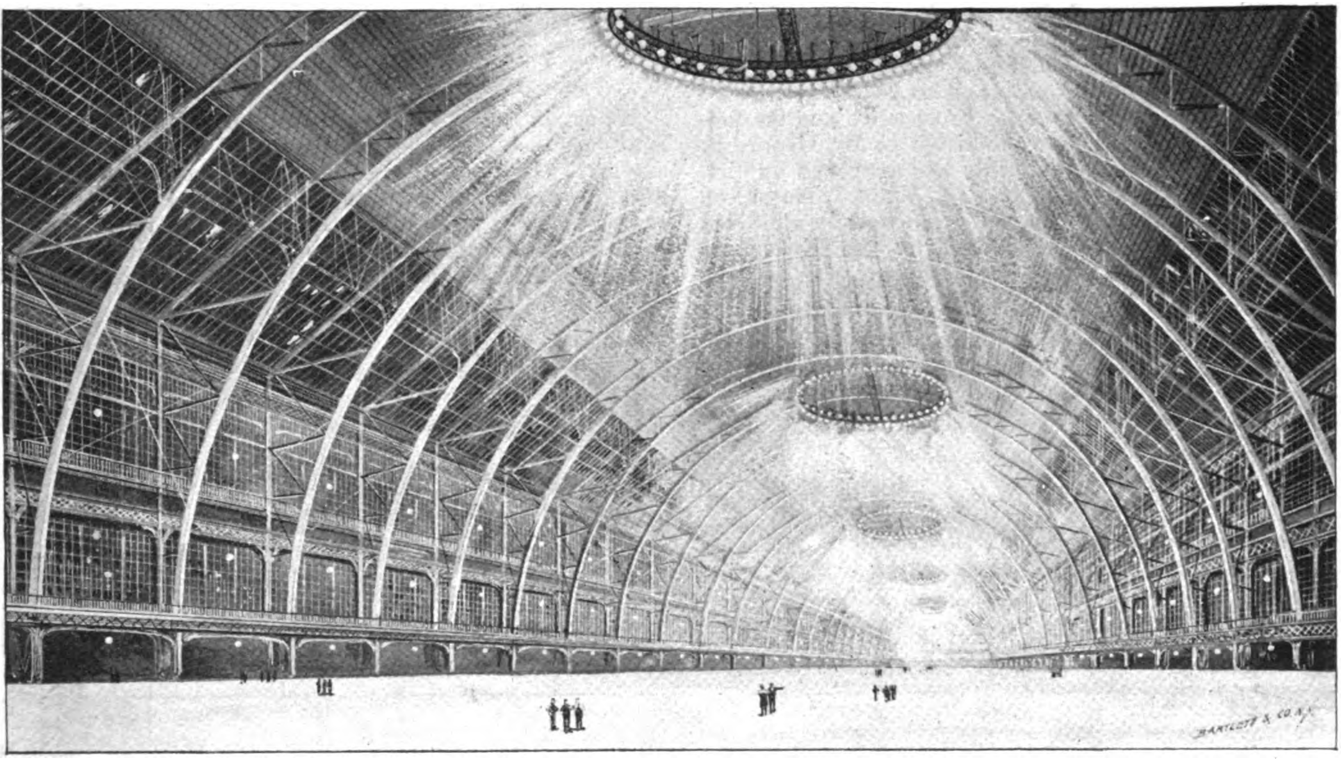
LIGHTING THE BIGGEST BUILDING IN THE WORLD.

BY

T. C. Martin

I.

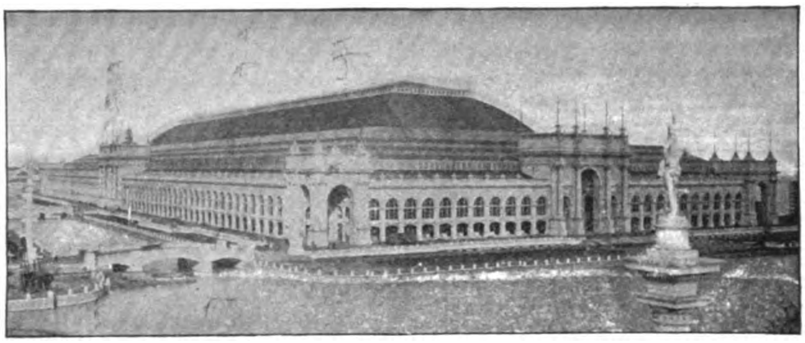
THE largest building at the World's Columbian Exposition is that provided for the Departments of Manufactures and Liberal Arts; and being the largest at the Fair, it follows, of course, that it is "the biggest in the world." This magnitude need not be regarded as anything derogatory to its merit. To some people, with whom mere size counts for little, the colossal World's Fair in Jackson Park is not much better than an architectural orgasm, having as slight a relation to supreme excellence and beauty of structure as Doré's sprawling pictures have to the essential merits of masterpieces in painting. But the most prejudiced person will admit that there are several buildings at the Fair of graceful and artistic design, while others may contend that the Manufactures Building is the finest in harmony of proportion that has ever been seen. Its Corinthian architecture is certainly very effective and imposing from whatever point of view, and especially from the Lake front or from the Midway Plaisance. Its brilliancy of tint—an ivory tone of color being used on the exterior staff or plaster—tends to give the vast bulk a curious lightness and airiness, and it is not until one has walked around it or paced up and down inside it that one realizes its ability to serve as a museum for several other well-known large buildings scattered about the Eastern States and Europe. Railway depots and churches could be stowed away in it as one stores furniture in a warehouse. It is 1,687 feet long, 787 feet wide, with a great arched roof 210 feet high and 368 feet wide. The ground floor area is over 30 acres, and the total area of floor including galleries is a modest 40 acres. The great interior space or court, that is, the quadrangle bounded by the galleries and inner walls, is 1,276 feet long and 380 feet wide. This space yawns "as big as all outdoors" as one looks up to the skylight roof and clear-story windows. It is worth while to have seen this great floor and hall before any exhibits have been placed. It will be even better to see it filled with the latest triumphs of genius, invention and art.


BARTLETT & CO. N.Y.

ELECTRIC ILLUMINATION OF THE MANUFACTURES AND LIBERAL ARTS BUILDING, CHICAGO WORLD'S FAIR.

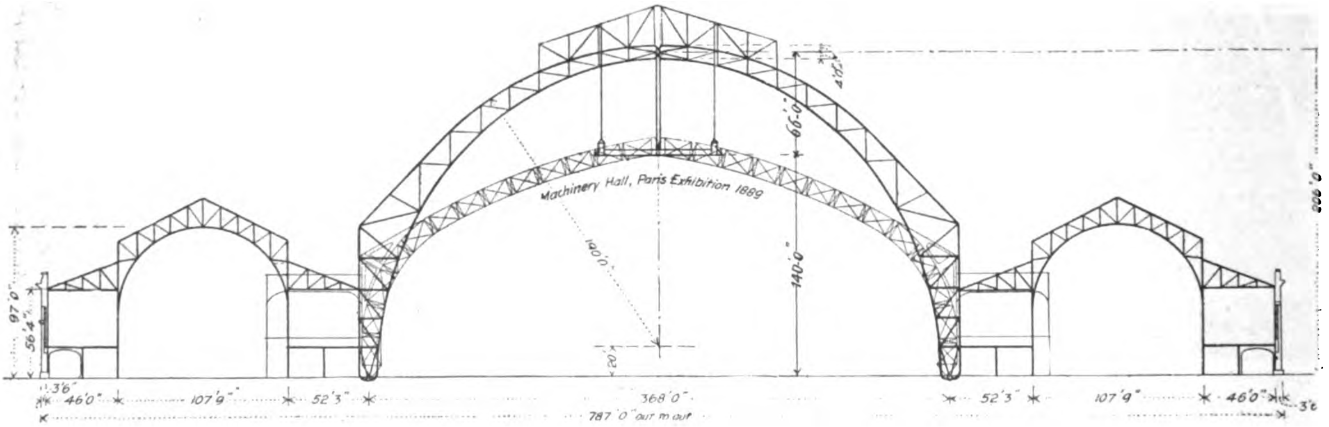
II.

One of the very first problems to present itself in connection with this little "40-acre farm" was to light it. Even were the authorities to adhere to their original intention of closing the Fair regularly at the hour of twilight, there would remain special evenings of fête to provide for, as well as occasional days of darkness and storm. But there were some farsighted men who insisted that a great boon



The Manufactures Building, Chicago World's Fair.

to the public during the hot summer months would be the opening of the Fair after dark—not perhaps all the buildings, but, in any event, those containing the greatest number of attractions. Moreover, it was pointed out that by opening at night, the Fair would practically double the number of months of its duration, and hence would be much better able to meet its cost and running expenses. It is now understood that these considerations have prevailed, and an announcement was made last week that the Fair would be open at night time. Be that as it may, and be the determining reasons what they may, the decision to light the Manufactures Building was arrived at some months ago, and the work of installation has just begun, after the utmost care and thought has been spent upon the general plan and upon the numerous important details. The ideas adopted are those of Mr. Luther Stieringer, the consulting electrical engineer of the Exposition, whose methods have, as usual, been marked here with great originality and ingenuity. The General Electric Company to whom the matter had been previously referred, were willing to carry out any scheme suggested, but informed Mr. D. H. Burnham, the Chief of Construction, that they left the selection of a plan to him and Mr. Stieringer. After the lighting had been carefully prospected, and its difficulties solved, the plans were submitted to Mr. George B. Post, the architect of the building, and approved by him. The plans were also submitted to Prof. Elihu Thomson, on the electrical engineering side, and were warmly approved again. They were finally adopted by the Exposition management, which, having to pay the piper, was as much interested as anybody in obtaining an adequate result economically.



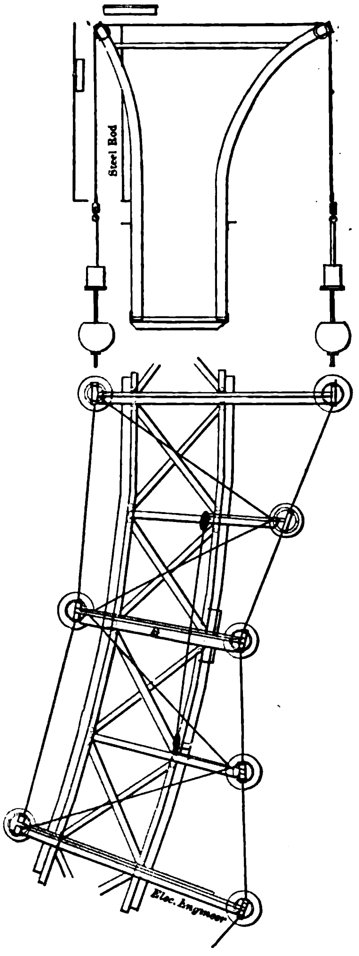
Transverse Sections of Manufactures Building, Chicago, and Machinery Hall, Paris.

III.

Exposition lighting is a new art, and when it deals with the illumination of such areas as the Manufactures Building, the few precedents are utterly useless. Until recently, it was supposed that exhibitors, like poultry, ought to go to roost at sundown, and only the introduction of the electric light changed the popular notion on this subject. At our New Orleans and Louisville Expositions, some extensive lighting was done with incandescents, under Mr. Stieringer's direction, and with pleasing result, but none of the spaces were large enough, or available, for broad effects with the arc light. Then came the very successful work in connection with the Paris Exposition of 1889, when an electrical syndicate assumed the contract of lighting certain parts of the Exposition in return for a proportion of the gate receipts at night. It is noteworthy that it was pointed out at that time by M. Hippolyte Fontaine, that the hours of earning capacity were increased from 1,620 to 2,500, and that the total cost of the exposition per hour was reduced from about $25,000 to $15,000. The Exposition authorities did not care to assume the expense and risk of a plant of their own, and therefore divided the gate money equally with the syndicate. The night fee was fixed at two francs on week days and one franc on Sunday; and the syndicate is said to have made a very good thing out of it. The public was delighted to have access to the cool grounds during the evening and to sit down at the cafés or stroll around listening to music, watching the electric fountains, or otherwise disporting itself in Parisian fashion. The night opening of the Exposition was not only one of its novel features, but among its chief successes.

IV.

When we come to examine the work done, however, it is at once seen that the precedents afforded are of little service. My object being to describe the lighting of the Manufactures Building, rather than that of the Fair generally, I may at once call attention to the fact that the *pièce de résistance* at Paris was the illumination of Machinery Hall, a magnificent building with a floor space of about 19 acres, and having a height of not quite 150 feet in the central nave (see page 307) The main lighting was done by a central series of bunches of 12 arc lamps, close up under the ridge of the roof. There were four of these clusters, and the lamps were of 60 amperes each, of about 3,000 c. p. Next in importance to these came 86 arc lamps of 25 amperes each, distributed in five longitudinal rows and suspended about 50 feet from the floor. The side galleries of Machinery Hall and the stands adjacent were lighted by 276 arc lamps of 8 amperes each, suspended about 16 feet from the floor. The illustrations of the plan and transverse section of the Hall indicate fairly well the location of the lights, the sectional view showing their relative height from the floor.

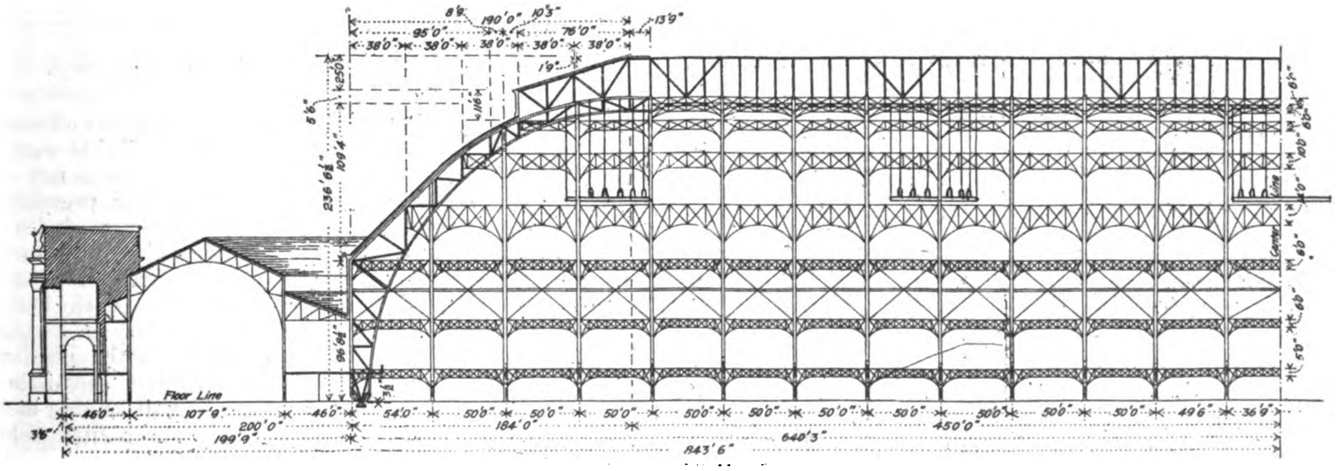


Method of Lamp Suspension.

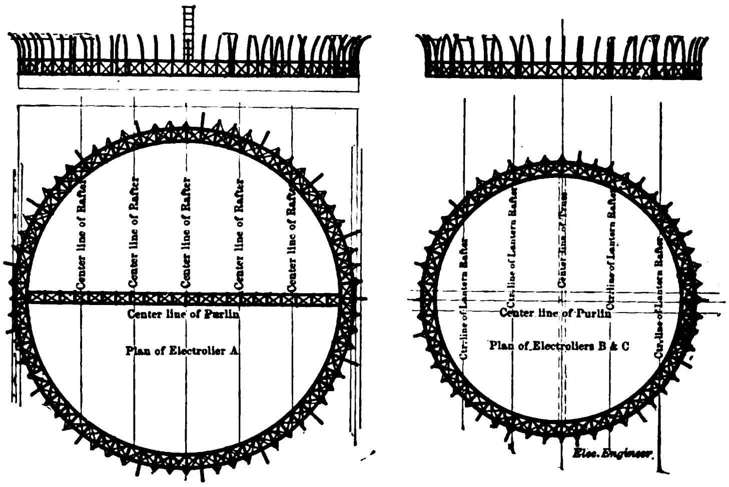
This was evidently a fine piece of lighting. M. Fontaine says of it in his monograph on the Exposition lighting: "It constituted, without question, the most important part of the operations of the syndicate. Never before had such a grand building been erected, and in the absence of sunlight, electricity alone was equal to the task of lighting it without detriment to its architectural effect." The impression derived by American electrical visitors was a favorable one; and it represented the latest word in the art up to date.

V.

The large sectional drawing on page 304 illustrates graphically the relative proportions of the two buildings now contrasted as to their lighting, as well as the original manner in which the vast central space of Mr. Post's grand hall is to be lit up. It will be seen at once that the famous Palais des Machines fits very snugly inside Manufactures Building, and that it is not much more than half as high. The plan elaborated by Mr. Stieringer has been to range five immense electroliers longitudinally, so that their coronas not only fill the void during the day but give an illumination at night the full equivalent of sunshine. The largest of these coronas hangs at the exact centre of the building, and has two smaller ones each side of it, at regular distances apart. These coronas are literally as big as circus rings. The largest has a diameter of 75 feet; the smallest, of no less than 60 feet. From the inner and outer lips of the large corona will hang a total of 102 arc lamps of 2,000 c. p. each. The smaller coronas carry 78 arcs each, of similar candlepower and similarly arranged. This makes a total of 414 arc lights shedding a radiance of 828,000 candle power, nominal, from a height of 140 feet from the floor, or about 60 feet from the roof. Hence the coronas are far above the line of vision, and constitute a row of artificial suns, giving light without warmth.



Half Longitudinal Section Showing Suspension of Coronas.



Plan of Large and Small Coronas.

The sectional view of Manufactures Building shows the manner of suspension for these huge rings or crater lips of white fire. There is in the large one a main steel shaft like the stem of the ordinary chandelier; but this would not give the support necessary, and hence hangers of wire rope are used as indicated. The steel shaft serves only as a ladder for descent into the ring. The lamp trimmer makes his way out across the roof to the shaft, and then goes down like a sailor in the rigging of a tall-masted clipper. Arrived at the corona rim by the transverse brace, he finds himself on a circular platform, resembling roughly the bridge of an ocean steamer. The platform is 2 feet 9 inches wide, and is protected by a high cross-lattice railing which rises on either side sufficiently to prevent any lofty tumbling, should one be suddenly afflicted with vertigo. The lamps are hung in pairs on davits by means of steel cables, zigzagging in and out so as to give the corona a starpointed appearance. In the large corona there are 17 star points and 13 in each of the smaller, as indicated in the drawings. In order to insulate the lamps thoroughly from the structure of steel and iron, the lamp cables pass through rubber thimbles at the davit arms; and heavy insulation is also used on all the conductors. The diagrams herewith show fully the method of arrangement and suspension. The lamps are grouped on 50 light-circuits, and will thus be operated, although there is a special all night circuit of 24 lights for police purposes. All the lamps are of 10 amperes and will be shaded with opal globes.

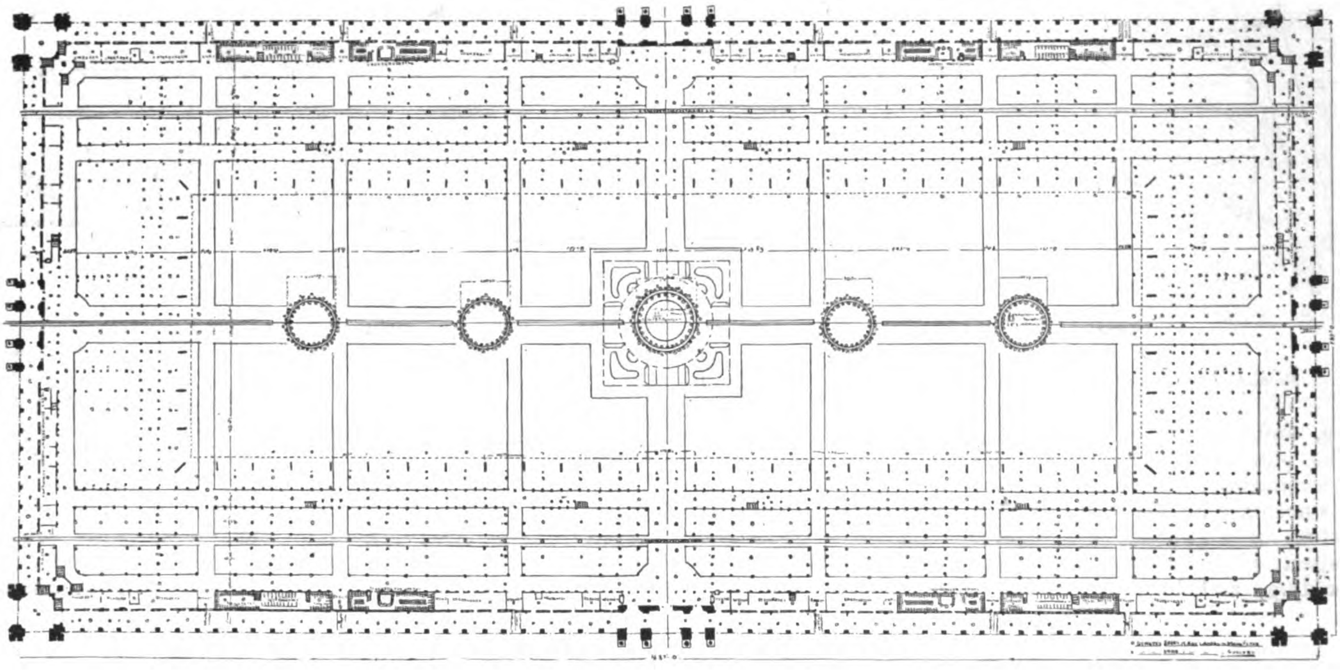
VI.

In addition to the coronas, a number of arc lights are judiciously disposed for the purpose of providing for the the lighting of the galleries and inner spaces where the direct lighting from the roof would be intercepted; also to reinforce the main lighting and outline the building or hall, emphasizing its grand proportions. Of such lights the number and disposition is given in the adjoining schedule, which further makes the comparison with the Palais des Machines, so as to give the proportion of lamps and candle-power to square feet of floor space in terms of 2,000 c. p. for the area inside the trusses.

MACHINERY HALL (PARIS).

Area inside of Trusses 347.75 × 1254 = 419,177.85 square feet.

86 lamps of 25 amperes,
5,000 c. p.
430,000 / 419,177.85 = per square feet 1.025, or in
215–2,000 c. p. lamps = one lamp to 1949.66 sq. feet.



PLAN OF MANUFACTURES BUILDING, WORLD'S FAIR, CHICAGO, SHOWING ARRANGEMENT OF LIGHTS.

48 lamps of 60 amperes,
12,000 c. p.
576,000 / 419,177.85 = per square feet 1.37, or in
288–2,000 c. p. lamps = one lamp to 1455.47 sq. feet.

48–12,000 c. p. lamps,
86– 5,000 c. p. lamps,
1,006,000 / 419,177.85 = per square feet 2.4, or in
503–2,000 c. p. lamps = one lamp to 833 square feet.

MANUFACTURES AND LIBERAL ARTS BUILDING, CHICAGO.

Area inside of Trusses, 354 × 1251 = 443,916 square feet.

420 lamps (414 in coronas).
2,000 c. p.
840,000 / 443,916 = per square feet 1.89, or in
420–2,000 c. p. lamps = one lamp to 1,056 square feet.
156 side lamps, at 600 square feet.......... 443,916
93,600
420 / 350,316 / 834 sq. ft. per lamp.

Gallery Floor.

		TOTAL
Over inside Gallery, inside row.	1 lamp to 1000 sq. ft.	68
Over inside Gallery, outside row.	1 lamp to 1200 "	76
Bridges...........................	1 lamp to 1250 "	112
Outside Gallery......	1 lamp to 2500 "	108
		364

Main Floor.

Centre......	1 lamp to 1056 sq. ft.	414
Face of Gallery..................	1 lamp to 600 "	68
Open Walls.......................	1 lamp to 1250 "	216
Under Bridges....................	1 lamp to 1250 "	112
Under inside Gallery, inside row.	1 lamp to 1800 "	68
Under inside Gallery, outside....	1 lamp to 1600 "	72
Portico.................... ..	1 lamp to 1375 "	184
		1134
Gallery Floor..................		364
Café and Rooms, Main Floor, est..................		200
Grand Total of Lights............		1698

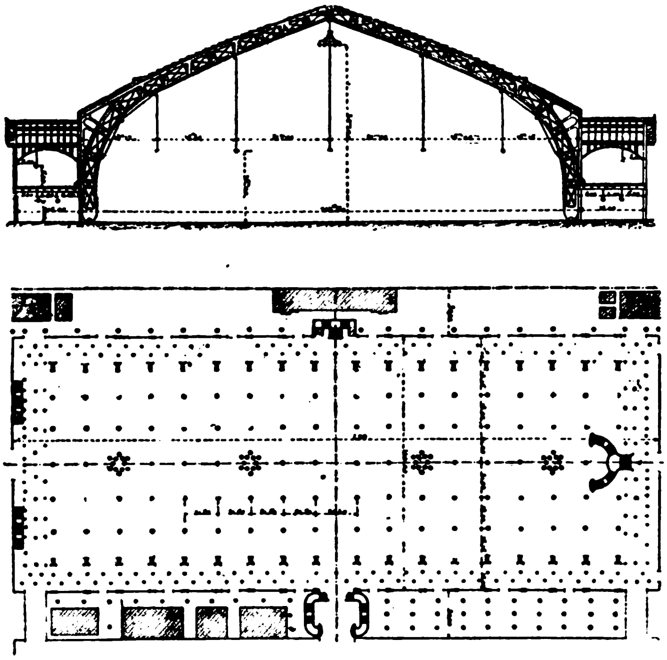
It may be added that the lights ranging along the aisles are about forty feet apart. In the loggias they are from 50 to 75 feet apart. Some 40 police lights are used around the building additional to those in the coronas, and there will be incandescent lighting in the rooms and to accentuate the exterior cornice of the building.

VII.

A few special features are worthy of note. In the Palais des Machines, the lamps used were of different candlepowers, and hence tended to neutralize each other to some extent The main cluster lights were also carried so close to the ceiling that part of their light was cut off rather than reflected downward. Moreover the lights were so bunched that the best results as to diffusion were not obtainable. In the Manufactures Building the peculiarity of having the lamps in two rings in each corona helps to make the lighting in the large spaces immediately below the coronas as good as it is beyond those areas, eliminating shadows and destroying also the otherwise dark hollow that would be enclosed by the lights were they in a single ring. The inner lights hang a little below the platform level, so that as a matter of fact one will see little of the corona details on looking up, and will be able merely to distinguish the rings of lamps, the one a little below the other.

Another point to be touched upon as one of novelty is the fact that these coronas do not hang by a central stem but are suspended entirely by the wire cables. In the large one, the central steel shaft is, as already stated, simply a ladder. In the smaller coronas, this rather contemptuous treatment of the stem is shown in placing it at one side of the ring, as a mere ladder and to get rid of the transverse bridge seen in the large corona. Moreover, most striking of all, the shafts have no radial arms extending to the circumference ; so that we have a fixture without either stem or radial branches. It will be seen on a little study that the weight of the structure at the end of a stem 70 feet long and at the extremity of so large a circle, rendered the old methods impossible. The cables used, hold up the circlets just as a trapeze bar is held up, and the weights have been calculated with a very large factor of safety.

The appearance of the lighting promises to be very fine. Mr. E. E. Bartlett has furnished an admirable sketch, from suggestions supplied by Mr. Stieringer, and his beautiful drawing is submitted for what it is worth as an effort to present the lighting effect artistically and faithfully. It must be borne in mind, that the designer of this lighting had to study economy in construction and in the use of current. He has placed as many arc lights in this building as the city of Philadelphia pays for on all its streets, and yet he has only about 2 c. p to the square foot. It would be easy to neutralize the most lavish supply of light by bad placing of the component parts and by a wrong choice of units.



Transverse Section of Machinery Hall, Paris Exposition, and Plan Showing Lights.

VIII.

As already stated, the lamps will be operated on 50-light circuits. The contract is in the hands of the General Electric Company, who are furnishing the requisite number of Thomson-Houston dynamos and lamps in the Machinery Hall power plant to take care of the work. The Exposition management will, however, have the running of the plant entirely in its own hands. The circuits will run from the switchboards in Machinery Hall through the subways of the Park to the building, and will be carried in at the proper points, the whole being under local control.

The iron and steel work for the coronas has been specially arranged by Mr. E. C. Shankland, engineer of construction, to whom the steel arch roof of the main court is due ; and to his personal interest in the matter, much of the success of the scheme is due. The metal work harmonizes thoroughly with the general design, and the coronas will have the appearance of being an integral part of the structure. The builders of the iron work are the Pittsburgh Bridge Company, of Pittsburgh, who thus find themselves embarked as pioneers in a new branch of the electrolier industry.

Acknowledgement is due to Mr. Luther Stieringer, the talented designer of the scheme, for access to the plans and for much of the data embodied in this article. As in all his other work, such as the exposition lighting of bygone years, or the towers of light in New York, Minneapolis, and Portland, one is impressed with an ingenuity equaled only by the careful study of every detail ; and it must be considered fortunate that a man of broad ideas and large grasp was allowed to deal freely with the unique problems of the case.

EARTH CURRENTS.

BY

W. Finn

Abnormal currents of natural electricity were again prevalent on the telegraph wires on Friday, March 17, though comparatively little interference with the regular working was caused by them. They first became active about 4 p. m., acquired a maximum force about 6 p. m., and were gradually subsiding when the writer ceased taking observations at 9.30 p. m. The following are some of the results of the measurements made over the Western Union wires during that time :

Earth Current Observations, March 17, 1893.

Time of Observation.	Wires grounded at	Distance	Approximate Resistance	Maximum Current Strength	Electromotive Force Developed
		Miles	Ohms	Milamperes	Volts
4.05 p. m.	Elizabeth, N. J.....	15	80	35	2.8
4.15 "	Bound Brook, N. J.	34	—	20	—
4.25 "	Philadelphia, Pa,..	91	2275	4	9.1
4.32 "	New Haven, Conn.	78	910	4	3.6
4.35 "	Boston, Mass.......	244	2825	7	19.7
4 40 "	Albany, N. Y.. ...	150	2850	2.5	7.1
4.42 "	Albany, N. Y......	147	1170	12	14.0
4.44 "	Middletown, Conn.	71	852	8	6.8
4.46 "	Scranton, Pa.......	149	840	8	6.7
4.49 "	Buffalo, N. Y......	422	1862	10	18.6
4.50 "	Albany, N. Y......	160	2220	5	11.1
4.54 "	Haverstraw, N. Y..	39	273	14	3.8
5.50 "	Harrisburg, Pa.....	197	1379	7	9.6
5.54 "	Pittsburgh, Pa.....	401	3145	5	15.7
6.01 "	Paterson, N. J.....	19	210	60	12.6
6.25 "	Pittsburgh, Pa.....	410	3420	4	13.6
7.10 "	Long Island City...	4¼	250	8	7.5
8.15 "	Buffalo, N. Y......	422	1800	3	5.4
8.22 to 8.50p.m.	Scranton, Pa.......	149	840	7	5.8
9.10 p. m.	Hackensack, N. J..	15	—	10	—

The disturbance was characterized by none of those violent fluctuations in the intensity and direction of the forces which formed so conspicuous a feature of last year's phenomena ; and at no time was the potential difference between any two grounds greater than about twenty volts.

The strength of the earth currents on some wires exceeded that of the regular signalling currents, though generally for brief periods only, while the rise and fall in value were marked with great deliberation, and without displaying the usual tendency to "reversals" of polarity. It is not to be wondered at, therefore, that the cable circuits were more or less free from interruption through the action of their line condensers which exclude all but the more variable classes of currents.

The recent phenomenon is particularly interesting at this time as affording another instance of that singular coincidence in the simultaneousness of sun spots and electric storms which naturally suggested some direct relationship between the two phenomena, but which Lord Kelvin now regards as highly improbable if not absolutely impossible in view of "the work which must be done at the sun to produce a terrestrial magnetic storm" even of small magnitude. In estimating, for instance, the energy required in the production of the magnetic storm of June 25, 1885, Lord Kelvin remarks in his recent address before the Royal Society, that during the eight hours of that not very severe disturbance "as much work must have been done by the sun in sending magnetic waves out in all directions through space, as he actually does in four months of his regular heat and light"—a result which would appear so incredible as to lead to the conclusion that "the supposed connection between magnetic storms and sun spots is unreal and that the seeming agreement between the periods has been a mere coincidence."

THE MOORE REGULATING LAMP SOCKET FOR ALTERNATING AND CONTINUOUS CURRENT.

BY

D. McFarlan Moore

THE device designed by myself for regulating the intensity of the light of incandescent lamps differs essentially from all others in that it is applicable with equal facility to both continuous and alternating circuits and obviates entirely the use of wasteful dead resistance. The radical departures consist, first in causing an external magnetic field to act upon an armature within a vacuum, and second, interrupting the current with such rapidity that the filament emits continuous light with an illuminating power corresponding to the rate of vibration of the armature.

This is accomplished by placing an electromagnet B, Fig. 1, in the hollow glass stem supporting the leading-in wires of an incandescent lamp. Inside the evacuated bulb and within inductive distance to the magnet is placed an armature, A, which vibrates in the same way as that of a vibrating contact bell.

The regulation is effected by the mechanical adjustment of the magnet. When the armature is not vibrated by the magnet, owing to the distance between them, it is at rest, and the filament being in circuit the light is at its maximum. When the magnet is moved towards the armature it will be attracted by the magnetism acting through the glass of the stem, and the current will be rapidly interrupted. Variations of the light may be obtained by varying the magnetic field by the movement of the magnet coil, which is accomplished by the milled head shown in Fig. 2. An attachment to the means for adjusting the magnet is used to break the circuit when it is desired to extinguish the lamp. Tests show that the volts and amperes vary directly with the light. As an illustration I give the accompanying table showing the amperes and volts taken by a 16 c. p. lamp from full brilliancy to the point at which the filament is just visible in the dark.

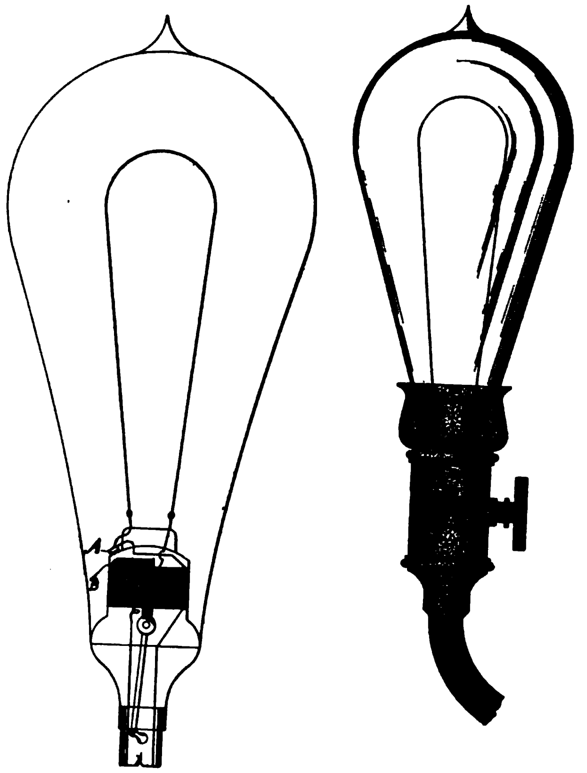
Ampere.	Volts.
.42 (full candle power)	115
.30	84
.17	52
.11	35
.07	20
.04	15
.03	10
.02 (just visible)	5

Still lower readings were taken, but below .02 ampere the heating of the filament was not discernible by the eye.

Inasmuch as the contacts are in a high vacuum they will remain bright and effective and the light can be regulated without the use of resistance, except that of the magnet, which is insignificant. The armature need be but the size of a pin head.

Besides the great advantage which the device offers in the regulation of the candlepower of the lamp, its ultimate influence on the art seems to me of even greater importance. Thus a lamp provided with such a regulating socket can be placed directly on a circuit carrying, say, 220 volts, or more, without being brought beyond its normal brilliancy. This means a great saving in conductors and must materially extend the economical limit of distribution for low tension lighting.

It must be also evident that the principle of vibrating contacts here embodied is applicable in general to any device intended for the regulation of current, and work is now actively going on looking to its application in the construction of simple and inexpensive devices which are intended to displace the cumbersome rheostats, current regulators, etc., so conspicuous in most electric installations.



FIGS. 1 AND 2.—MOORE REGULATING LAMP SOCKET.

COUNTRY HOUSE LIGHTING.

EARL RUSSELL and Mr. Thwaite, in an article in the *National* (British) *Review*, propose that the owners of country houses shall combine for the purpose of establishing a central station at some fixed place to supply light to the surrounding residences. A skilled working electrician should be engaged to supervise the generating plant. At the central station a steam engine, or a fuel-gas engine, would drive alternating dynamos. The E. M. F. developed at a low pressure, would be transformed into one of greater pressure, and suitable for the distance to be traversed between the station and the houses, and the pressure of the current would be reduced at each house to the measure appropriate to the character of the work to be done.

STREET LIGHTING BY PRIVATE VERSUS MUNICIPAL PLANTS.

BY

HORATIO A. FOSTER.

THERE appeared in the February number of the *Review of Reviews* an article by Robert J. Finley entitled "*Electric Street Lighting in American Cities: The Question of Municipal versus Private Supply.*"

He calls attention to the increase of lighting by municipal plants and presents two comparative tables showing cost per arc light per year in cities operating their own plants and in cities supplied by private companies. Now, tables of costs for comparison should be based on some unit common to all the figures in order to be of any use, and such is certainly not the case in these tables.

A price per annum or per night for an arc lamp is all well enough to enable a city to make a comparison of its own prices or cost from year to year, provided always that the lamps are burned the same number of hours each year.

It is quite obvious that a price per year for Madison, Ind., where the lamps are burned but six hours per night is not truly comparable with the price per annum at Bangor, Me., where the lamps are burned all night.

In order to make a more useful comparison of these data I have reduced the figures in both the tables to a lamp-hour basis and herewith present these tables of the results.

In the Table I for municipal plants I have omitted Decatur, Ill.; Ypsilanti, Mich.; and Easton, Pa., as the period of illumination is not definitely stated. In Table II of private companies, Danville, Ill.; Fort Scott, Kan.; Owensborough, Ky.; Allentown, Pa., and South Bethlehem, Pa., have been omitted for similar reasons.

The hours per night are taken as stated in his tables and foot notes, and are assumed to be for 365 nights per annum.

Table I shows the results for 19 cities operating their own plants: Table II exhibits the results for the 24 cities lighted by private plants, and Table III is a comparison of the results of the two previous tables with names of the states opposite the respective prices.

TABLE I.

19 cities operating electric lighting plants	Number of arc lamps 2,000 c. p.	Hours burned per night for 365 nights	Total lamp hours per annum	Calculated cost per annum per lamp	a Cost per lamp per hour	Total cost of plant	Cost of plant per lamp	12 per cent. on cost of lamp for depreciation and interest	b Depreciation and interest per lamp per hour	Total cost to city per lamp per hour a + b
1. Little Rock, Ark.	111	8.	2920	$54.00	.0185	$35,000	$317	$38.04	.0130	.0315
2. Aurora, Ill.	81	7.6	2775	66.69	.0240	43,000	531	63.72	.0229	.0469
3. Bloomington, Ill.	240	10.¼	3741	50.00	.0134	80,000	333	39.96	.0106	.0240
4. Elgin, Ill.	80	10.	3650	43.00	.0118	23,000	288	34.56	.0095	.0213
5. Moline, Ill.	80	10.¼	3741	53.00	.0141	21,000	263	31.56	.0084	.0225
6. Paris, Ill.	60	7.	2555	40.00	.0156	9,600	160	19.20	.0075	.0231
7. Madison, Ind.	85	6.	2190	58.50	.0267	25,000	294	35.28	.0161	.0428
8. Topeka, Kan.	184	10.¼	3741	97.50	.0260	50,000	272	32.64	.0087	.0347
9. Bowling Green, Ky.	60	6.	2190	50.00	.0228	15,000	250	30.00	.0137	.0365
10. Bangor, Me.	140	10.¼	3741	45.00	.0120	35,000	250	30.00	.0080	.0200
11. Lewiston, Me.	100	6.	2190	54.75	.0250	15,000	150	18.00	.0082	.0332
12. Bay City, Mich.	143	6.	2190	58.00	.0265	30,000	210	25.20	.0115	.0380
13. St. Joseph, Mo.	208	8.	2920	72.00	.0246	55,000	264	31.68	.0108	.0354
14. Galion, O.	73	6.	2190	35.00	.0160	23,000	315	37.80	.0171	.0331
15. Marietta, O.	65	5.⅛	1872	38.00	.0202	13,000	200	24.00	.0128	.0330
16. Chambersburg, Pa.	62	6.	2190	45.00	.0205	34,500	556	66.72	.0340	.0545
17. Meadville, Pa.	74	7.	2555	47.43	.0185	20,000	270	32.40	.0126	.0311
18. Titusville, Pa.	60	10.	3650	40.00	.0109	9,000	150	18.00	.0049	.0158
19. Galveston, Tex.	175	7.	2555	87.60	.0342	40,000	228	27.36	.0107	.0449
Averages...	....	....	2819	$54.49	.0201	——	$279	$33.48	.0123	.0328

NOTE.—Taxes on the cost of plant that would be paid to the city by a private company should be added to the cost of lighting.

By a comparison of this kind we have all prices based on a common unit and the true result is shown, *if the statistics are correct.* It will now be noticed that, in many cases, prices by private plants are as low as or lower than the same by the municipal plant.

It would be quite interesting to know the data in detail of the operating expenses of these municipal plants, and whether they were run by steam or water; for the results in many cases are surprisingly low. Perhaps if the statistics were gathered in person rather than by correspondence, quite different results would have been shown. We have high authority for the statement that statistics obtained by correspondence are comparatively useless.

TABLE II.

24 cities supplied by private companies.	Number of arc lamps 2,000 c. p.	Hours burned per night for 365 nights	Total lamp hours per annum	Price per lamp per annum	Price per lamp per hour
1. Texarkana, Ark.	31	10¼	3741	$160.	.0428
2. Jacksonville, Ill.	71	6	2190	96.	.0437
3. Joliet, Ill.	121	10¼	3741	124.	.0331
4. Peoria, Ill.	233	6	2190	145.	.0662
5. Springfield, Ill.	130	6	2190	137.	.0625
6. Streator, Ill.	60	10¼	3741	96.	.0256
7. Kokomo, Ind.	56	10¼	3741	100.	.0267
8. Logansport, Ind.	85	6	2190	100.	.0456
9. Arkansas City, Kan.	35	5⅛	1872	72.	.0384
10. Augusta, Me.	68	9	3285	76.33	.0232
11. Bath, Me.	31	6⅛	2237	125.	.0528
12. Grand Rapids, Mich.	120	10¼	3741	109.50	.0293
13. Lansing, Mich.	100	6	2190	100.	.0456
14. Kansas City, Mo	128	10¼	3741	200.75	.0534
15. Sedalia, Mo.	92	6	2190	87.	.0398
16. Springfield, Mo.	54	6	2190	136.	.0620
17. Bellaire, O.	52	6	2190	90.	.0410
18. Tremont, O.	70	10¼	3741	90.	.0240
19. Hillsborough, O.	63	6	2190	70.	.0320
20. Lebanon, Pa.	60	5⅛	1872	80.	.0427
21. New Castle, Pa.	50	10¼	3741	80.	.0214
22. Dallas, Tex.	165	10¼	3741	95.85	.0258
23. Houston, Tex.	92	10¼	3741	150.	.0400
24. Parkersburg, Va	58	10¼	3741	102.	.0272
Averages.....			2922	$109.27	.0393

It is rare indeed to find a true statistician in charge of the books of account of a municipality or even a person who will take the time to give full and accurate information.

The writer of this has had considerable personal experience in this very line during the past two years and is exceedingly skeptical of any data gathered as these are said to have been.

Then again in the absence of more data, the cost per lamp of the municipal plants varies rather inconsistently. Two cities it appears from Mr. Finley's tables, paid but $150 per lamp while two others paid more than $500 per lamp for their plant.

In fact the costs generally are rather high, as one of the best known manufacturing companies considers $250 per lamp sufficient for a complete and first class installation.

It must be borne in mind that all the figures in the accompanying tables are taken from the data as stated in Mr. Finley's paper.

If it is possible for a municipality or any other corporation to run arc lamps for .0109 per lamp hour, as is indicated by the figures for Titusville, Pa.,[1] it is quite time the owners of private plants knew it and just how it is done; for I think I am safe in saying that few if any of them are able to duplicate the figures, and 2½ or 3 times that price would be much nearer the true cost.

TABLE III.

CITIES AS PER TABLES I AND II		Cost per lamp per hour mun-icipal plants	Price per lamp per hour private plants	STATES
Municipal	Private			
1. Little Rock.....	1. Texarkana......	.0315	.0428	Arkansas
2. Aurora.........	2. Jacksonville....	.0469	0437	Illinois
3. Bloomington ...	3. Joliet...........	.0240	.0331	"
4. Elgin...........	4. Peoria..........	.0213	.0662	"
5. Moline	5. Springfield......	.0225	.0625	"
6. Paris............	6. Streator	.0231	.0256	"
7. Madison........	7. Kokomo.......	.0428	.0267	Indiana
—	8. Logansport...	—	.0456	"
8. Topeka.........	9. Arkansas City..	.0347	.0384	Kansas
10. Bangor	10. Augusta	.0200	.0232	Maine
11. Lewiston	11. Bath	.0332	.0528	"
12. Bay City........	12. Grand Rapids ..	.0380	.0293	Michigan
—	13. Lansing	—	.0456	"
13. St. Joseph......	14. Kansas City....	.0354	.0534	Missouri
—	15. Sedalia.........	—	.0398	"
—	16. Springfield	—	.0620	"
14. Galion..........	17. Bellaire	.0331	.0410	Ohio
15. Marietta.......	18. Tremont	.0330	.0240	"
—	19. Hillsborough ...	—	.0320	"
16. Chambersburg..	20. Lebanon........	.0545	.0427	Pa.
17. Meadville.......	21. New Castle.....	.0311	.0214	"
19. Galveston	22. Dallas..........	.0449	.0258	Texas
—	23. Houston	—	.0400	"
—	24. Parkersburg....	—	.0272	Virginia
Averages....	....	.0328	.0393	

Writers on this subject would be much less open to criticism if they would be more careful to get correct data and then reduce them to a lamp-hour basis as I have done with Mr. Finley's figures.

QUICK WORK OF THE CABLE.

THE perfection which ocean telegraphy has attained was illustrated last week by the feat accomplished by the Direct United States Cable Company in signalling the result of the Oxford-Cambridge boat race to the United Press within 13 seconds of the finish. The race was ended at 4 o'clock 51 minutes 47 seconds P. M., Greenwich time, and the result was announced to the United Press in New York, over the Direct Cable at 4:52 P. M., Greenwich time—less than a quarter of a minute being consumed in obtaining the news at the course, forwarding it through London and across the Atlantic, and signaling it to the New York office of the United Press.

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[1] The conditions of affairs at Titusville is so disgraceful that the city has resolved to give up its plant and to make a contract with the local company. The lighting under the municipal management is described as worse than wretched, and the circuits are reported to us by an expert to be in a criminally neglected condition. See article on page 319.—EDS. E. E.

A CONVERTIBLE SYSTEM OF ARC LIGHTING AND CONSTANT POTENTIAL POWER SERVICE.

BY

S. H. Rushmore.

IT is a remarkable fact that, while great strides have been made in incandescent lighting and power apparatus, each year showing distinct advance towards simplicity and economy, the arc lighting systems which are now in such extensive use show very little improvement over the practice of five or six years ago. The great effort of designers and builders to-day is to attain greater efficiency with cheaper and more compact apparatus, and these efforts seem to have been barren of results, as applied to the arc light systems, and the reasons for this are well known to every arc light station manager.

The great advance in alternating and direct current incandescent apparatus has been largely due to the construction of larger units, and in this direction the arc light machines are restricted by the limitations of voltage. The present arc light machine, at its very best barely shows an efficiency of 60 per cent., while that of the large constant potential generators is usually 95 per cent. and over.

The cause of this great difference is easily understood when we consider the conditions. While there are machines built and used that will run 100 lights, and more, in series, the conditions under which most large municipal plants operate, do not allow circuits much over 50 lights each; and as each circuit must have its separate dynamo, we see as the result that large plants are compelled to use swarms of small buzzing machines requiring ten times the space as the same output of constant potential generators.

Aside from the question of efficiency and floor space, with the present arc light apparatus, the great disadvantage is that an arc dynamo can be commercially used to operate arc lamps only, and as a result, all arc stations, no matter how large, must remain practically idle during the hours of sunlight. In this direction the incandescent system is far in the lead, and there are few such stations in this country in which the all-day motor service is not a source of large income. While several of the Edison stations are doing a large arc light business, it is understood by all familiar with the two systems, that this class of service does not begin to meet the requirements of the average municipal plant.

It was with the view of combining the good points of the constant current and constant potential systems, that the writer devised and patented the system described below. The main object aimed at is to enable constant current circuits in which translating devices are employed in series, such as arc lighting circuits, to be supplied in an effective and convenient manner by constant potential generators, such as are ordinarily used for incandescent electric lighting and for electric motor work. Thus by this method it is possible to supply from the same generators and the same central station, both arc lights and incandescent lights, as well as electric motors, whereby an increase of economy and profit is obtained. In carrying out the invention in practice it is preferable to employ a series of constant potential generators of the usual type used for supplying incandescent or power circuits, the number of generators which may be placed in series being proportioned to the number of arc lamps to be supplied in series, and these generators are so connected that the full potential of the entire series may be directed upon one or more series circuits of lamps; this potential may, however, be varied when necessary, partly by the individual regulation of the generators and partly by placing a greater or less number of such generators in series. Switches are provided, so arranged that the generators may be altogether removed from their series relation, and all applied in multiple arc to incandescent or power circuits. Thus the station may be employed in the day time on constant potential circuits, supplying power to factories, railways, etc., and at night may be used to supply both arc lamps, and a portion of the power load.

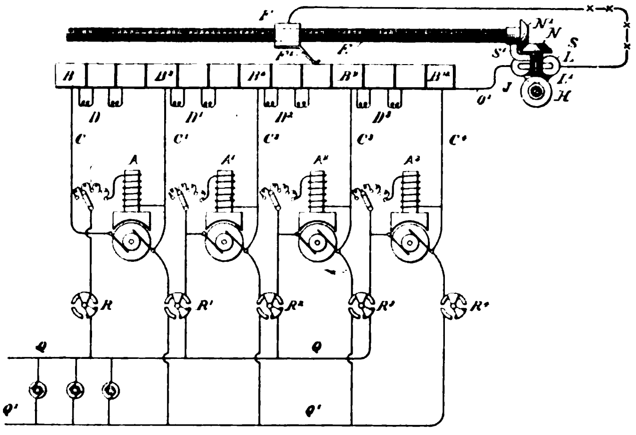

FIG. 1.

The regulation of the generators, in accordance with the variation in the number of arc lamps in series, is accomplished by automatically-operating devices controlled by the current in each circuit, the accompanying diagrams illustrating the methods employed. Fig. 1 is a diagram of the system. Fig. 2 is a general diagram of a modified arrangement, in which each generator has several independent armature coils, connected externally in series; and Fig. 3, shows the method of supplying two or more series circuits from the same generator.

In Fig. 1 A, A^1, A^2 and A^3 represent suitable generators of the constant potential type. These generators are all shown as connected in series through the switches R, R^1, R^2, R^3, R^4. B to B^{12} is a series of contacts insulated from one another. One terminal of a series of generators is connected by wire C with contact block B, the other terminal by wire C^4 with contact block B^{12}. Intermediate connections C^1, C^2 and C^3, are made from between the generators to contacts B^3, B^6 and B^9 respectively, and those contacts to which connections are made are connected with adjacent contacts on one side, through resistance coils D, D^1, D^2, D^3. From the wire C^4, which is at one terminal of the series of generators, a conductor O^1, extends, which after including the coils of magnet L^1, whose function will be presently explained, passes to the series circuit containing arc lamps X, the other end of this circuit being connected with the traveling nut F, threaded on the shaft E, and carrying the contact spring F^1, which moves over the series of contacts B to B^{12}.

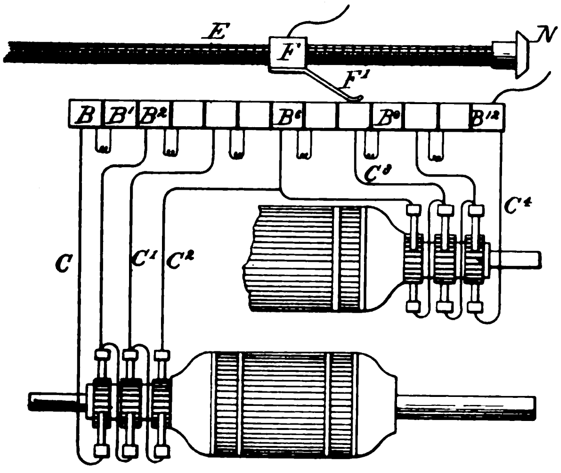

FIG. 2.

It will be seen that when the spring F^1 rests on the end block B, the series circuit O^1 will receive the full potential of the series of generators, but if the spring is moved to the right, the potential will be diminished first by the including of resistance coils D in circuit, then by the removal of the generator A, when the spring reaches the block B^3; then by further including of resistance, and following this the removal of generator A^1, and so on, until at the position indicated in Fig. 1 the series circuit is supplied by the generators A^2 and A^3 through the resistance coils connected between blocks B^6 and B^8. On movement in the other direction it is evident that the potential of the series circuit will be gradually increased in the same manner.

In addition to their regulating function, the resistance coils D D act to prevent short circuiting when the spring F^1 bridges two contacts. This movement of the contact spring F^1 can be accomplished in any simple manner, by means of a regulator similar to that used on arc light machines. The series of generators may supply any desired number of series circuits, these being in multiple arc relation to each other, and each circuit having its own automatic regulator. The arrangement of two or more series circuits is indicated in Fig. 3.

It will be seen that each circuit will therefore be regulated in accordance with the number of translating devices which it contains at any time. As shown, the traveling contact will assume different positions on the range of contacts, in accordance with the voltage required by each circuit; and when the number of lamps in the circuits is varying, each traveling contact will move back and forth upon the contacts, in accordance with the requirements of its particular circuit. In Fig. 1 is shown an additional constant potential circuit Q, Q^1 connected with switches R to R^4. This may be a power circuit containing electric motors and supplied from the same generators.

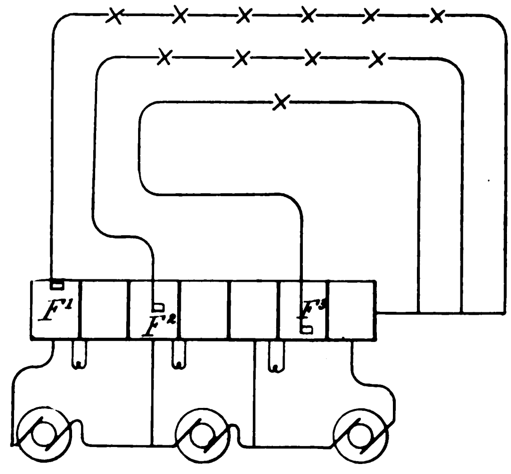

FIG. 3.

It will be seen that by turning the switches, all the generators may be connected in multiple arc with the circuit Q, Q^1, so that at this time all the machines supply a single multiple arc system. It is designed that the system may be operated in this way in the day time, when arc lights are not in use, and that at night the power circuit will be disconnected at the switches R to R^4, and the series of generators thrown upon the arc light circuits. Fig. 2 shows generators, each of whose armatures has several independent windings and commutators. These commutators being joined in series, are connected with contacts B to B^{12} in the same manner as the individual machines of Fig. 1.

The only objection of importance which has been urged against this system is, that the arc lights will sometimes be required before the power circuit is cut off; but this can readily be overcome by having a few machines capable of standing excessive overload for a short time, to carry the power load at night and during the period of early arc lighting.

Under this system, a station of 2,000 lights would require, say, ten ordinary 250-volt machines of 200 amperes capacity each; whereas under the present system 40 are required with four times the floor space and with a continual loss of over 35 per cent., or 700 h. p., and allow no power service.

NON-SYNCHRONOUS MOTORS FOR ORDINARY ALTERNATING CURRENTS.—A REPLY TO MR. C. E. L. BROWN.

BY

L. Gutmann

It was with great interest that I read the article of Mr. C. E. L. Brown in The Electrical Engineer of Feb. 8, and it is for the first time that a well-known European engineer begins to take a stand for the single-phase alternating current motor. At the time when everybody in Europe believed that there was nothing like the multiphase motors, the writer alone defended the motor operated by an ordinary alternating current.

Mr. Brown is correct when he says that thus far no commercial alternating current motors are on the market, but he is incorrect when stating that the motors designed and patented so far "have been more or less unsatisfactory because none have been adopted in practice." The reason that a motor like that described by Mr. Brown has not been adopted is simply because it has not been manufactured and consequently could not be introduced.

Very properly he calls attention to the magnetic resistance of the air gap and abnormal magnetizing current, which still seems to be a great mystery to many. Formerly the low efficiency was attributed to the great self-induction. If this had been the only cause no doubt some successful motors having at least a fair efficiency might have been designed and used in Europe where alternating currents of low frequency are at home. The writer believes that the real trouble will be revealed when the magnetic field is explored. It will then be found that, depending on the type selected, the mechanical air gap and the electrical air gap are not alike in length. The worst type is the single horseshoe in which the mechanical air gap may be from $\frac{1}{16}$ to $\frac{1}{4}$ inch while the magnetic air gap in motors and especially with permanently or temporarily closed circuits may vary from $\frac{1}{16}$ to 3 and more inches, depending on the size and position of the closed circuit.

This fact once known leads one to ironclad field magnets and armatures with the smallest possible air gap adapted to prevent the stray field.

It probably is new that a solid and symmetrical conductor would remain in synchronism when once brought up to that speed and exert energy to remain in synchronism; however, it is well known that a single coil disposed unsymmetrically or a number of closed coils mounted symmetrically around the circumference of an armature would always exert energy to remain in synchronism, if once brought up to that point.

It may be mentioned, however, that Mr. Brown is antedated by the writer and that referring especially to the armature, your readers will no doubt remember the description of a motor illustrated in this journal during the summer of 1891, which shows an armature with permanently closed subcircuits, a form which is believed to be original with the writer and which is properly protected.

Owing to circumstances the writer has had but very little occasion to experiment and then only with makeshift devices; nevertheless he has succeeded in designing two distinct types of self-starting synchronous motors with permanent circuit connections,—therefore, not covered by the patent of Prof. Thomson; these types cannot be published as yet.

These machines are a step in advance of the induction motor and will, it is confidently believed, develop into machines consuming less energizing current than induction motors.

It would be very interesting, no doubt, to many of your readers if Mr. Brown would publish some tests in regard current consumption in his motors at varying loads.

IS THIS A NON-INFRINGING TELEPHONE?

The Electrical Engineer is informed that a telephone is soon to be placed on the market, whose construction is as follows: The diaphragm is of mica; attached to the under side of this plate are several short iron wires, close together, but not touching. Two coils are used and instead of their plane being parallel with the diaphragm, it is perpendicular to it. Instead of a permanent magnet, a soft iron core is employed, which of course necessitates the use of battery. The telephone seems to work fully as well on short lines as the ordinary magneto receiver. Preparations are being made to supply these instruments in large quantities, and if the American Bell Telephone Company can find anything in their construction that infringes the second Bell patent—that of Jan. 30, 1877, which will expire next January—the public will doubtless soon be informed as to what it is. Following are the claims of this Bell patent:

1. The union upon, and by means of, an electric circuit of two or more instruments, constructed for operation substantially as herein shown and described, so that, if motion of any kind or form be produced in any way in the armature of any one of the said instruments, the armatures of all the other instruments on the same circuit will be moved in like manner and form; and if such motion be produced in the former by sound, like sound will be produced by the motion of the latter.

2. In a system of electric telegraphy or telephony, consisting of transmitting and receiving instruments united upon an electric circuit, the production, in the armature of each receiving instrument, of any given motion by subjecting said armature to an attraction varying in intensity, however such variation may be produced in the magnet, and hence I claim the production of any given sound or sounds from the armature of the receiving instrument, by subjecting said armature to an attraction varying in intensity, in such manner as to throw the armature into that form of vibration that characterizes the given sound or sounds.

3. The combination, with an electromagnet, of a plate of iron, or steel, or other material capable of inductive action, which can be thrown into vibration by the movement of surrounding air, or by the attraction of a magnet

4. In combination with a plate and electromagnet, as before claimed, the means herein described, or their mechanical equivalents, of adjusting the relative position of the two, so that, without touching, they may be set as closely together as possible.

5. The formation, in an electric telephone, such as herein shown and described, of a magnet with a coil upon the end or ends of the magnet nearest the plate.

6. The combination, with an electric telephone, such as described, of a sounding box, substantially as herein shown and set forth.

7. In combination with an electric telephone, as herein described, the employment of a speaking or hearing tube, for conveying sounds to or from the telephone, substantially as set forth.

8. In a system of electric telephony, the combination of a permanent magnet with a plate of iron or steel, or other material capable of inductive action, with coils upon the end or ends of said magnet nearest the plate, substantially as set forth.

The 3d, 5th, 6th, 7th and 8th of these claims have been construed by the Supreme Court of the United States as follows:

"The patent itself is for the mechanical structure of an electric telephone to be used to produce the electrical action on which the first patent rests. The third claim is for the use in such instruments of a diaphragm, made of a plate of iron or steel, or other material capable of inductive action; the fifth, of a permanent magnet constructed as described with a coil upon the end or ends nearest the plate; the sixth, of a sounding box as described; the seventh, of a speaking or hearing tube as described for conveying the sounds; and the eighth, of a permanent magnet and plate combined. The claim is not for these several things in and of themselves, but for an electric telephone in the construction of which these things or any of them are used."

If there never had been any patent No. 174,465, of March 7, 1876, the inventor of the telephone described herein holds that his telephone would not infringe any of these claims. As, however, the construction and operation of his instrument are similar, with one or two improvements, to those of Fig. 7. shown and referred to in the first Bell patent (now expired), he believes he is doubly sure of not infringing.

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Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
Western Editor and Manager, L. W. COLLINS. 575 The Rookery, Chicago, Ill.
New York Representative, 208 Broadway, } W. F. HANKS.
Philadelphia Representative, 501 Girard Building, }

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XV. NEW YORK, MARCH 29, 1893. No. 256.

ELECTRIC LIGHTING AND VENTILATION.

THE introduction of electric lighting into modern buildings has brought about changes in more than one collateral branch of industry, and new instances are constantly arising involving changes in methods heretofore in vogue. One of the earliest, and still one of the most powerful, arguments in favor of the electric light, is the total absence of any products of combustion from the light-giving body, in virtue of which the atmosphere remains pure, and hence more healthful to the occupants of the rooms in which it is used. The large reduction in the quantity of heat emitted from the incandescent lamp as compared with the gas flame, was also long since pointed out as a factor in its favor. Taking both these factors into consideration the influence of the incandescent lamp, therefore, on the heating and ventilating of our large modern buildings will be readily grasped ; but just to what extent the introduction of the electric light has modified previous practice, may not be so generally known.

The questions here involved we find admirably treated in a lecture by Mr. Alfred Wolff, M. E., delivered before the Franklin Institute. In the course of his analysis, which has been fully established by experience gained in actual practice, Mr. Wolff points out the interesting fact that the quantity of steam required for heating and ventilating large buildings equals closely the amount used independently for their electric lighting. It will thus be evident that by the introduction of electric light the entire heat value of the steam is utilized. This conclusion carried out still further implies that the boiler capacity employed for heating and ventilating will also take care of the electric lighting for a large building, or vice versa ; and hence in the winter months electric lighting is secured at only a slightly increased fuel expense. The results here shown emphasize again the great desirability of the modern architect bringing to his aid the electrical, and the heating and the ventilating engineer. Thus, what at one time were considered matters of secondary consideration, compared with the purely architectural execution of the building, are gradually being brought up to their true level of importance, with the result that the modern building is thoroughly comfortable and habitable.

LIGHTING BY PHOSPHORESCENCE.

IT is now more than 40 years since Geissler startled the scientific world with the brilliant colors and fantastic shapes of his tubes, phosphorescing with the residual gases and vapors of elements. How to enhance the effects produced in this manner soon after became the subject of much speculation. But even the brilliant work of Crookes failed to advance the subject materially so far as the practical solution of the problem was concerned. It is therefore with more than ordinary interest that we observe the attempts now being made in England, on the lines of the latest ideas, to develop apparatus intended for the commercial utilization of lighting by phosphorescence. The results obtained by Messrs. Pike and Harris in connection with Sir David Salomons, though they may not be sufficiently advanced to warrant the assertion, that they afford a practical solution of the problem, nevertheless appear to be of great promise. It is to be hoped that these investigators will continue their efforts and that others may be encouraged to work in a field which has been shown to be capable of yielding a rich harvest.

Another Telephone.

WE print elsewhere in this issue a brief description of a new "non-infringing" telephone. The instrument has been designed by its inventor to be substantially similar to the apparatus exhibited in the famous Figure 7 of the first Bell patent. By using a soft iron core instead of a permanent magnet, a mica diaphragm with a series of short iron wires pasted upon it, instead of a plate of iron or steel or other material capable of inductive action, and by an ingenious reverse winding of the iron core to nullify self-induction, the designer of this telephone believes he has an operative device which does not infringe the second Bell patent which does not expire until January 30, 1894. How well he has succeeded, our readers may judge for themselves by comparing the telephone as described with the 3d, 5th, 6th, 7th and 8th claims of the patent of 1877, and their interpretation by the Supreme Court.

The Cost of Steam Power.

PENDING the development and utilization of other more economical methods of generating current than by the power-driven dynamo, we must still in the majority of cases look to steam and the steam engine for our source. The extent to which the item of power-cost figures in the total operating expenses of central stations, and the influence thereon of the various types of engine in vogue, are therefore still questions of paramount importance; and Dr. Charles E. Emery has placed the electrical profession under lasting obligations by the presentation of his exhaustive paper before the American Institute of Electrical Engineers, an abstract which we print elsewhere. The tables embodied in Dr. Emery's paper, together with his conclusions, should be closely studied by all users of steam power.

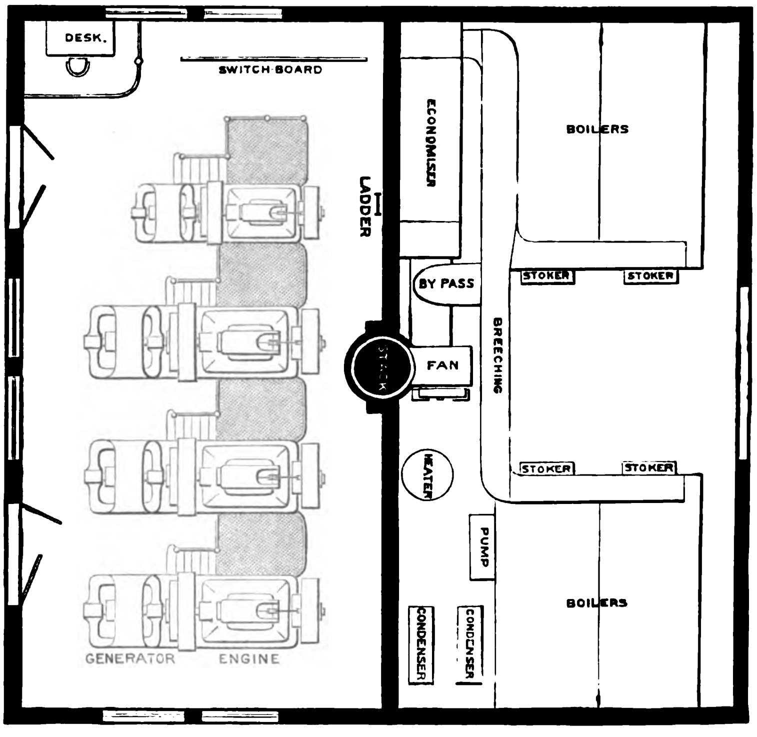
ELECTRIC RAILWAY DEPARTMENT.

DESIGNS FOR A SUBURBAN RAILWAY POWER PLANT.

We illustrate by half tone from the architect's perspective, a power station recently designed by Westinghouse, Church, Kerr & Co., engineers, for the Newton and Boston Street Railway, Newtonville, Mass. The special interestattached to this design is from the fact that it was originally prepared in view of the location of the station on an attractive residence street in one of the most beautiful suburbs of Boston. A lot was subsequently determined upon where space and appearance were not important, and the station was re-designed and constructed on a different plan. There is enough that is unique and suggestive in this preliminary design to warrant its publication, notwithstanding the fact that it was not carried out in this form.

The proposed location of the station was such as to make desirable a neat building in harmony with the general surroundings, but without involving any considerable increase of cost. The entire annihilation of smoke was an imperative consideration. An iron stack with guy rods was inadmissible from its vulgarity, and a brick chimney stack, always expensive, was particularly so in this instance, from the uncertain nature of the foundations. The plan was finally worked out so as to effectively conceal the chimney stack and indeed to so disguise the building, that while retaining the general appearance of practical solidity appropriate to its work, it should at the same time in its suburban architecture be suggestive of a pumping station, if not of a public library.

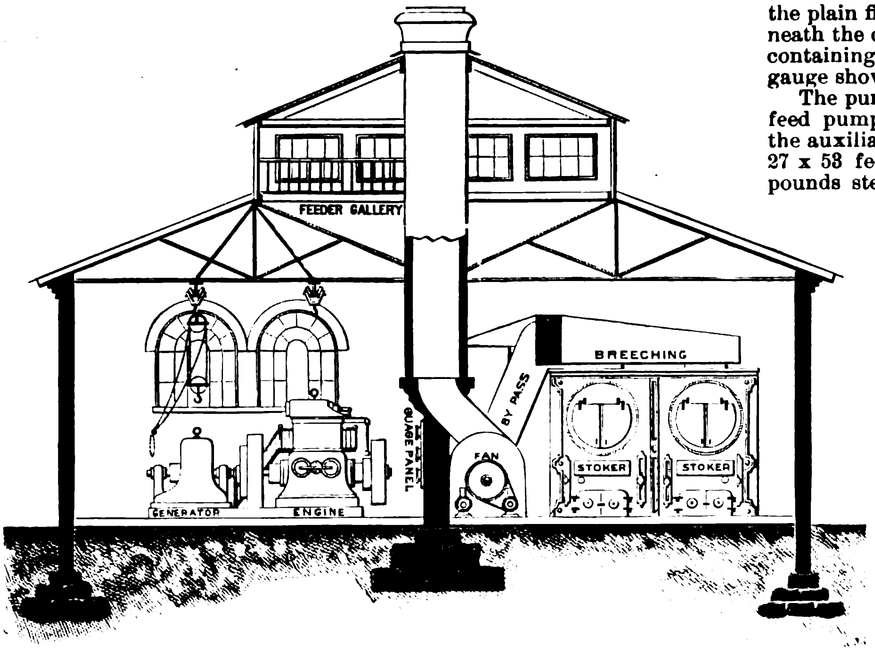
The outside dimensions of the building are 55 x 58 feet, which space serves to contain a generating plant of 580 rated horsepower with relay boiler capacity, economizer, stack, condenser, and all the usual auxiliaries. The building is 20 feet in height to the roof line, rising to a total height of 40 feet at the top of the stack. The walls are faced with cream colored brick with blue stone trimmings. The roof is of iron, inexpensive in construction, from the fact that the building is divided by a parti-wall between the engine and the boiler room, thus reducing the span of the truss one-half. The roof hips from the corners, and is slate covered and finished on the inside with wire lath and plaster. A monitor 28 x 80 feet affords abundant light and ventilation to both the engine and boiler-room, and at the same time makes a convenient tower from which to lead away the feeder wires. The latter are accessible from an interior iron gallery, reached by an iron wall-ladder. As this power house was to be located on a street on which there was much driving, it was thought best to make the machinery invisible from the street, and so avoid the danger of frightening horses. To this end, the windows were raised to a height of eight feet above the floor line, and were effectively treated from an architectural standpoint to harmonize with the general subject.



Plan of Power Plant.

The generator-room, 28 x 53 feet, contains one 100 h. p. and three 160 h. p. "Kodaks," any piece of which can be handled from an overhead trolley-fall and tram. In this particular station it seemed necessary to have one small unit of 100 h. p. available for the all-night service demanded by the residence character of the city. Ample space is left at one end of the room for the switchboard and for the engineer's desk. The interior walls are left in the plain finish of the brick and painted. On the pilaster underneath the chimney stack is displayed a black marble gauge-board containing a clock, steam and vacuum gauges, and a manometer gauge showing the draft in the stack.

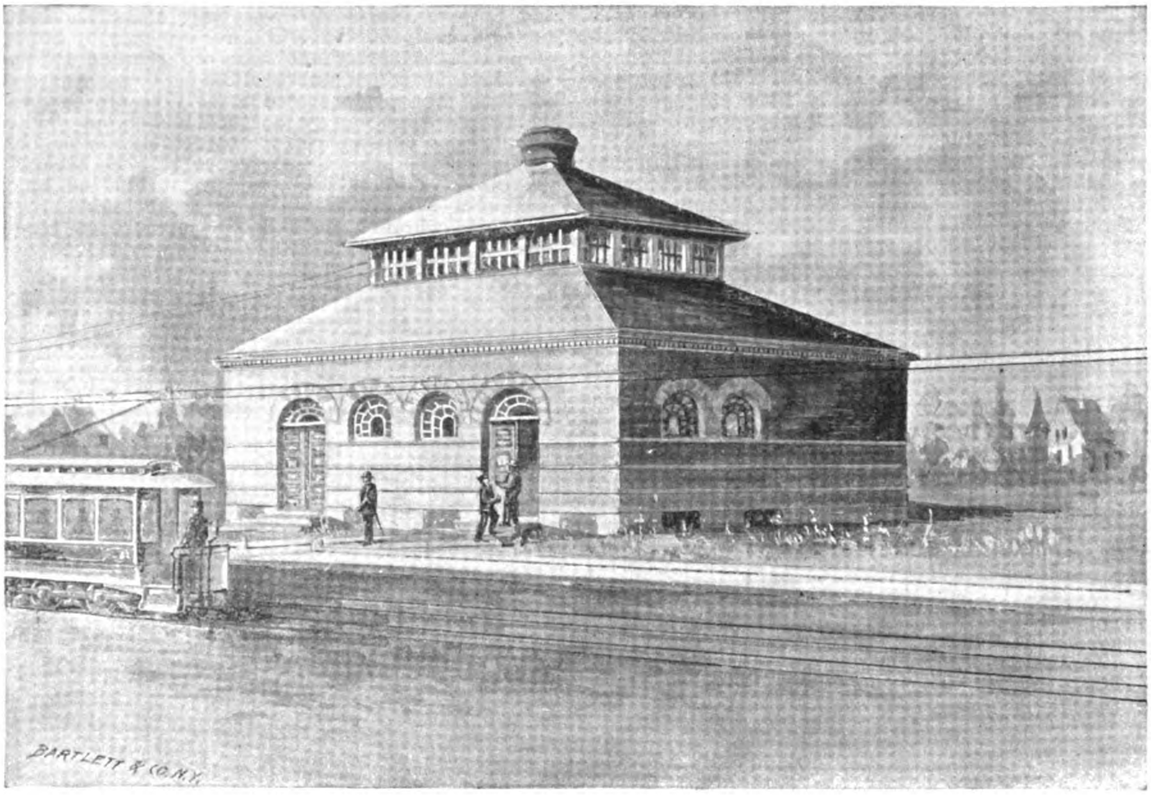
The pump-room contains two independent condensers, double feed pumps, and a fore-heater for condensing the exhaust from the auxiliary pump cylinders, condenser, etc. The boiler-room, 27 x 53 feet contains four Babcock & Wilcox boilers to carry 125 pounds steam pressure, three of which represent the capacity of the entire plant, the fourth being relay. Each of these boilers is fitted with a Roney mechanical stoker for the purpose, in part, of securing the necessary smokelessness, and in part, for the sake of its superior economy in burning cheap mixed fuels. No coal or ash handling machinery was employed on account of the small size of the plant. The smoke connections from all four of the boilers unite and pass to the rear of an economizer, through which the gases are drawn by a large, slow running exhaust fan, driven by an independent engine using about ½ h. p. The smoke connections are heavily covered with non-conducting material, in order that all heat of the boiler gases may be utilized in the economizer. A by-pass is provided direct from the breeching to the fan inlet in case of repairs to the economizer. The fan discharges directly up into the bottom of a stack five feet in diameter and lined with one course of common brick. The stack is of steel and supported on an entablature carried in the parti-wall, the base being 10 feet six inches above the floor line. It is in the exact centre of the building, in order that its top shall appear as a finial at the peak of the monitor roof. In this



Sectional View, Suburban Railway Power Plant.

position, one-half of the stack shows in the generator room, where it is covered with nonconducting material, and painted to correspond with the walls.

The general plan is one on which, with appropriate variations, all Kodak stations can safely be based. The cost of the building is reduced to a minimum, other things being equal. The defect of this particular type of builing is, that it does not admit of ready extension, and is, therefore, in the form here shown, desirable only when the ultimate capacity of the plant can be safely predetermined. For this reason, as much as any other, it was finally decided to locate the power station of this particular road in a less conspicuous position, and re-design the plant on different lines, so that indefinite extension could be provided for to meet the unknown growth of suburban railway traffic.


BARTLETT & CO. N.Y.

PERSPECTIVE VIEW OF A POWER STATION DESIGNED FOR A NEW ENGLAND SUBURB.

THE TROLLEY CAR HAS SOME RIGHTS.

A JURY in the United States Court, at Providence, R. I., refused to believe that Henry Marquand was injured $15,000 worth by being thrown at Newport from his horse, which it is claimed, was frightened by a trolley car.

Mr. Marquand said he saw the car 600 feet away, but he claimed that he had some rights, and wasn't going to exert himself to get out of the way.

The jury found for the defendant, the Newport Street Railway Co., their opinion being that Mr. Marquand did not own the whole highway, but that the street railway cars as a means of great public benefit had some rights, too.

THE TROLLEY ON THE ORANGE MOUNTAIN.

THE owners of the Orange Mountain cable road, and a number of Boston capitalists, are negotiating for the purchase of the Orange Crosstown and Bloomfield Street Railway, and they have an option on it until the first of April. Frank W. Childs, of Orange, is conducting the negotiations, but the price named could not be learned. It is proposed to operate the line by electricity, and also to extend it north through Brookdale to Paterson and also south to South Orange, and probably to Milburn and Morristown. A spur will also be built from the Washington street terminus through Watchung Heights to Montclair, and another branch is to run through Hurlbut street and other throughfares to East Orange. The Orange Mountain Cable Company, which has now almost completed its road up the mountain side, has plans drawn for a road leading from its base to the Highland avenue station of the Morris and Essex Railroad, whence it is proposed to extend it north to the Green in West Orange.

The New Jersey Traction Company has also acquired the right of way for a line running south from its main road in West Orange to Central avenue and thence east to East Orange, through which it is proposed to run to the power house in Newark. The company is also to build a new power house at the base of the Orange Mountain and extend its line up the slope to Eagle Rock. These proposed lines will all be operated by electricity and will form a network of rails through the Oranges. Even more extensive improvements and prolongations are contemplated in the near future.

PROVIDENCE, R. I., AS AN ELECTRIC RAILROAD CENTRE.

A SYNDICATE of Providence, New York and Boston bankers, headed in New England by Messrs. Lee, Higginson & Co., offers for public subscription $5,000,000 Providence & Pawtucket five per cent. street railway bonds.

This is the combination now controlling the street railway system of Providence and adjoining towns and serving a population of 235,000 people. It is proposed to equip the entire system with electricity, increase the mileage from 82¾ miles to 104 miles, and to generally develop the properties so as to increase the gross earnings beyond the present income of the aggregate companies of $1,225,000. But with present gross earnings an electrical equipment means net income of about $500,000, or double the interest upon the present issue of $5,000,000 five per cent. bonds which are offered at par and interest by the most conservative bankers in New England and New York. It is understood that the Rhode Island Hospital Trust Company, which joined with the bankers in the offer, has taken $2,000,000 of the bonds upon its own account.

PERSONAL.

MR F. E. DONOHOE, the well-known selling agent of the U. S. Wire and Cable Company, has severed his connection with that concern and has joined the forces of the Safety Insulated Wire and Cable Company, of this city.

MR. ROBB MACKIE, E. E., the city electrician of Cincinnati, O., has resigned that position, although offered $1,000 increase of salary by the Board of Aldermen. He is to make his residence in New York City.

MISCELLANEOUS.

THE COST OF STEAM POWER PRODUCED WITH ENGINES OF DIFFERENT TYPES UNDER PRACTICAL CONDITIONS, WITH SUPPLEMENT RELATING TO WATER POWER.[1]—I.

BY CHARLES E. EMERY, PH. D.

(1) THE author first refers to his previous paper on "The Cost of Steam Power," published in the Transactions of the American Society of Civil Engineers in 1883, stating that he had been urged to modify it to suit more recent conditions, but that he believes it still substantially correct for the particular purposes for which it was originally designed, to wit: to show the capitalized or present value of steam power in different units maintained forever. The prices of engines have varied since the paper was prepared, but this fact has proportionally little effect on the results, and in any case corrections must be made for the difference in prices of fuel.

(2) The author has therefore decided in the present paper to compare the cost of developing a given amount of power with several of the different kinds of engines now in general use. A unit of 500 net horse-power has been selected, which it is assumed is delivered at a speed of 250 to 350 revolutions per minute, corresponding to the jack shaft speed of slow speed engines and the actual speed of high speed engines.

(3) While the writer attempts to examine all the principal causes which affect the cost of steam power, the prominent feature of the discussion is the substantial equalization of the cost of the power developed with engines of different types and different degrees of economy when expenses independent of the coal consumed are considered. Attention is called to the fact that such expenses are fairly constant and will in some cases equal the cost of coal. The result is, that if one engine saves a certain large percentage of fuel compared with another, such percentage is reduced one-half when applied to the double quantity, and in many cases the lower percentage will be balanced or more than balanced by the difference in interest on the cost of the different engines.

(10) The writer submits Table 1, showing in detail the cost of one horse-power per year developed in engines of different kinds when operated for 10 hours per day for 308 days in the year, and for 20 hours per day for every day in the year, with columns showing the results in each case for coal costing $2.00, $3.00, $4.00 and $5.00 per ton. The results are at first presented on the basis that the power required is comparatively steady so that no surplus machinery is required. A second presentation shows the results for electric light and other plants in case 50 per cent. surplus machinery be provided to supply the maximum power during certain portions of the day and the power for the remainder of the day be sufficiently low to maintain the average.

(11) The different lines of the table refer to engines of the types stated in column *b*. The author states that the last three lines are devoted to low speed condensing triple compound engines. Of these, line *J* shows the probable results with machinery designed to secure economy in construction rather than the highest economy of fuel. Line *K* refers to a low speed triple compound engine more expensively constructed, for which the economy is assumed lower than in the other case and for which the results are believed to be the best that can be secured under ordinary average practice even with the best machinery. There has, however, for comparison, been added another line, *L*, assumed to be operated at still lower economy by the use of boilers of unusual economy and careful attention to the details of operation, for which purpose $1.00 per day is added to the labor acc unt. The results shown in this line are believed to be the maximum which can be obtained under the conditions of unusually good practice with the best care available.

The author then proceeds to describe the several columns of the table. Most of these will be understood by reading the headings. We note, however, the following:

(13) In column *c*, the indicated horse-power required to produce 500 net horse-power has been fixed at 542 for the high speed engines and 556 for the low speed engines, to include the friction of transmission to the jack shaft.

(15) Columns *e* and *f* relate to the feed water per indicated horse-power per hour; column *e* showing the probable limits within which the feed water required will vary for engines of the types stated, when constructed by different manufacturers or operated under different conditions. The lower limit is believed to have been fixed in each case at the minimum result which has been obtained by reliable experiments with the class of engines referred to; these figures are therefore too low for average practice. The larger figures in column *e* represent results which in the opinion of the writer may be obtained under less favorable but practical circumstances, and of course still larger costs would result from the use of apparatus imperfectly designed or improperly operated. Column *f* shows the feed water per indicated horse-power per hour assumed for comparison. The figures in this column are not intended to be averages of those given in column *e*, but those which can be safely depended upon under conditions of practice, with the load varying between considerable limits, thereby affecting somewhat the economy. It should be stated that the desire to have these figures decrease progressively where possible has somewhat influenced the values selected as well as the above considerations. Engines operating cotton mills or large numbers of small machines of any kind under conditions securing a substantially uniform load will necessarily give nearer the minimum results shown in column *e*, but engines generating

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
						$g=\frac{fc}{30}$		$i=\frac{g\times 22 \text{ or } 25}{500}$	$j=\frac{8.125g}{500}+5.50$	$k=h+i+j$	$l=1.085k$		$n=\frac{f}{m}$	$o=\frac{11cn}{2240}$	$p=\frac{21cn}{2240}$
DESIGNATION.	TYPE OF ENGINE.	INDICATED HORSE POWER required to produce 500 Horse Power Net on High Speed Engine Shaft, or Jack Shaft of Low Speed Engine.	STEAM PRESSURE BY GAUGE	FEED WATER PER INDICATED HORSE POWER PER HOUR.		COMMERCIAL HORSE POWER of Boilers on basis that one Commercial Horse Power requires the evaporation of 30 pounds of water at 70 lbs. pressure from temperature of 100°.	APPROXIMATE COST PER NET HORSE POWER OF					WATER EVAPORATED PER POUND OF COAL.	COAL PER INDICATED HORSE POWER PER HOUR.	TONS OF COAL (OF 2240 LBS.) PER DAY WITH AVERAGE COAL FOR ONE HOUR ADDED FOR STARTING AND STOPPING FIRES.	
	NAME.			Probable Limits.	Assumed for Comparison.		ENGINES ERECTED AND CONNECTED READY FOR OPERATION.	Boilers erected and connected ready for operation on basis of $22.00 per Commercial Horse Power for steam pressure of 125 lbs. or under and $25.00 for higher pressures.	BUILDINGS AND CHIMNEY	TOTAL OF THE THREE PREVIOUS COLUMNS.	Total with 2½ per cent. for inspection and 6 per cent. for loss of interest during construction added.			For 10 working hours per day.	For 20 working hours per day.
		I. H. P.	Lbs. per sq. in.	Lbs.	Lbs.	C. H. P.	Dols.	Dols.	Dols.	Dols.	Dols.	Lbs.	Lbs.	Tons.	Tons.
A	Simple High Speed, Non-Condensing…	542	100 to 120	35 to 26	33	596	17.50	26.22	15.18	58.90	63.91	8.5	3.882	10.332	19.725
B	" Low " " " …	556	100 to 120	32 to 24	29	537	25.00	23.63	14.22	62.85	68.19	8.5	3.412	9.316	17.785
C	Compound High " " ..	542	100 to 120	30 to 22	26	470	21.00	20.68	13.13	54.81	59.47	8.5	3.059	8.142	15.544
D	Special Triple Compound High Speed Non-Condensing } ……..	542	150 to 170	27 to 21	24	434	26.00	21.70	12.55	60.25	65.37	8.5	2.824	7.516	14.349
E	Simple High Speed Condensing……	542	100 to 120	25 to 19	22	397	21.00	17.47	11.95	50.42	54.71	8.5	2.588	6.888	13.150
F	" Low " " ……	556	100 to 120	24 to 18	20	371	27.00	16.32	11.53	54.85	59.51	8.5	2.353	6.425	12.265
G	Compound High " ……..	542	100 to 120	24 to 16	20	361	24.50	15.88	11.36	51.74	56.14	8.5	2.353	6.263	11.956
H	" Low " " ……	556	110 to 125	20 to 12½	18	334	30.00	14.70	10.92	55.62	60.35	8.5	2.118	5.783	11.040
I	Special Triple Compound High Speed Condensing } …………	542	150 to 170	23 to 14	17	307	29.00	15.35	10.49	54.84	59.50	8.5	2.000	5.323	10.163
J	Triple Compound Low Speed Condensing	556	150 to 170	18 to 12½	16	297	37.50	14.85	10.32	62.67	68.00	8.5	1.882	5.139	9.810
K	do do	556	160 to 170	17 to 12¼	15	278	45.00	13.90	8.35	67.25	72.97	8.5	1.765	4.819	9.200
L	Do For Probable Maximum Results….	556	160 to 170	16 to 12¼	14	259	45.00	12.95	8.15	66.10	71.72	9.5	1.474	4.085	7.683

TABLE 1, SHOWING COST OF STEAM POWER.

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[1] An abstract of a Paper read before the American Institute of Electrical Engineers, March 21, 1893. For convenience of reference to the original paper the paragraphs in the abstract have been numbered to correspond with the original paper.

electric current for electric railways or subject to variable loads of any kind will rarely show economies as low as has been assumed for comparison in column *f*.

(16) Column *g* shows the commercial horse-power of boilers on the now accepted basis of 80 pounds of feed water per horse-power. It will be noticed that the high speed non-condensing engines in line *A* require 596 boiler horse-power to produce 500 net horse-power, and that the power of the boilers continually diminishes with the reduction in feed water per horse power, so that for the case last named, line *L*, only 259 boiler or commercial horse-power is required.

a	q	r	s	t	u	v	w	x	y	z	A	B	C	D	E	F
	$q=\frac{2\times 308e}{900}$	$r=\frac{3\times 308e}{900}$	$s=\frac{4\times 308e}{900}$	$t=\frac{5\times 308e}{900}$	$u=\frac{2\times 365f}{900}$	$v=\frac{3\times 365f}{900}$	$w=\frac{4\times 365f}{900}$	$x=\frac{5\times 365f}{900}$	$y=\frac{3080\times .48 \text{ or } .41}{900}$	$z=\frac{7300\times .48 \text{ or } .41}{900}$	$A=\frac{(.008g+3)\times 308}{900}$	$B=\frac{(.008g+3)\times 365\times 2}{900}$	$C=0.05h$	$D=\frac{i}{10}$	$E=y+A+C+D$	$F=z+B+C+D$
	COST OF COAL PER HORSE POWER PER YEAR								COST PER NET HORSE POWER PER YEAR OF SUPPLIES AND AVERAGE REPAIRS.		COST PER NET HORSE POWER PER YEAR OF WAGES.		COST OF INSURANCE ½ PER CENT.; OF TAXES 1.2 PER CENT. OF RENEWALS 3.3 PER CENT. TOTAL 5 PER CENT. OF COSTS IN COL. *h*.	INTEREST OR DIVIDENDS SAY 10 PER CENT. OF COSTS IN COL. *i*.	TOTAL COST PER HORSE POWER PER YEAR OF ALL OPERATING, CURRENT AND INTEREST EXPENDITURES EXCEPT COAL	
	ON BASIS OF 308 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2240 POUNDS DELIVERED AS FOLLOWS:				ON BASIS OF 365 DAYS OF 20 HOURS EACH AND COST OF COAL PER TON OF 2240 POUNDS DELIVERED AS FOLLOWS:				308 days of 10 hours each.	365 days of 20 hours each.	308 days of 10 hours each.	365 days of 20 hours each.			308 days of 10 hours each.	365 days of 20 hours each.
	$2.00	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00								
	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.
A	12.73	19.09	25.46	31.82	28.80	43.20	57.60	72.00	2.96	7.01	4.78	11.34	2.95	6.39	17.08	27.69
B	11.48	17.22	22.96	28.69	25 97	38.95	51.93	64.92	2.53	5.99	4.49	10.65	3.14	6.82	16.98	26.60
C	10.03	15.05	20.06	25.08	22.69	34.04	45.39	56.74	2.96	7.01	4,16	9.87	2.74	5.95	15.81	25.57
D	9.26	13.89	18.52	23.15	20.95	31.42	41.90	52.37	2.96	7.01	3.99	9.45	3.01	6.54	16.50	26.01
E	8.49	12.73	16.97	21.22	19.20	28.80	38.40	48.00	2.96	7.01	3.81	9.02	2.52	5.47	14.76	24.02
F	7.92	11.87	15.83	19.79	17.91	26.86	35.81	44.77	2.53	5.99	3.68	8.71	2.74	5.95	14.90	23.39
G	7.72	11.57	15 43	19.29	17.46	26.18	34.91	43.64	2.96	7.01	3.63	8.60	2.59	5.61	14.79	23.81
H	7.13	10.69	14.25	17.81	16.12	24.18	32.24	40.30	2.53	5.99	3.49	8.28	2.78	6.04	14.84	23.09
I	6.56	9.84	13.12	16.40	14.84	22.26	29.68	37.10	2.96	7.01	3.36	7.97	2.74	5.95	15.01	23.67
J	6.33	9.50	12.66	15.83	14.32	21.48	28.65	35.81	2.53	5.99	3.31	7.85	3.13	6.80	15.77	23.77
K	5.94	8.91	11.87	14.84	13.43	20.15	26.86	33.58	2.53	5.99	3.22	7.63	3.36	7.30	16.41	24.28
L	4.96	7.44	9.92	12.40	11.22	16.83	22.43	28.04	2.53	5.99	3.74	8.87	3.31	7.17	16.75	25.34

TABLE 1 (CONTINUED), SHOWING COST OF STEAM POWER.

$C_1 = .0405\,k + .06\,h + .075\,i$

a	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	a
	$G=q+E$	$H=r+E$	$I=s+E$	$J=t+E$	$K=u+F$	$L=v+F$	$M=w+F$	$N=x+F$	$O=q+y+A+\frac{3}{2}D+C_1$	$P=r+y+A+\frac{3}{2}D+C_1$	$Q=s+y+A+\frac{3}{2}D+C_1$	$R=t+y+A+\frac{3}{2}D+C_1$	$S=u+z+B+\frac{3}{2}D+C_1$	$T=v+z+B+\frac{3}{2}D+C_1$	$U=w+z+B+\frac{3}{2}D+C_1$	$V=x+z+B+\frac{3}{2}D+C_1$	
	TOTAL COST PER NET HORSE POWER PER YEAR ON BASIS OF								TOTAL COST PER NET HORSE POWER PER YEAR FOR ELECTRIC R. R. AND OTHER VARIABLE WORK REQUIRING 50 PER CENT. EXTRA PLANT TO OBTAIN ON THE AVERAGE 500 H. P INSURANCE INCREASED TO 1½ PER CENT., ENGINE RENEWALS TO 4 PER CENT. AND BOILER RENEWALS TO 5 PER CENT								
	308 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2240 LBS. AS FOLLOWS:				365 DAYS OF 20 HOURS EACH AND COST OF COAL PER TON OF 2240 LBS. AS FOLLOWS:				FOR 308 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2240 LBS. AS FOLLOWS:				FOR 365 DAYS OF 20 HOURS EACH AND COST OF COAL PER TON OF 2240 LBS. AS FOLLOWS:				
	$2.00	$3.00	$4.00	$5.00	$2.co	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00	
	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	
A	29.81	36.17	42.54	48.90	56.49	70.89	85.29	99.69	35.45	41.82	48.19	54.55	62.14	76.54	90.94	105.34	A
B	28.46	34.20	39.94	45.67	52.57	65 55	78.53	91.52	34.55	40.28	46.02	51.75	58.65	71.64	84.61	97.60	B
C	25.84	30.86	35.87	40.89	48.26	59.61	70.96	82.31	31.10	36.12	41.13	46.15	53.52	64.87	76.22	87.57	C
D	25.76	30.39	35.02	39.65	46.96	57.43	67.91	78.38	31.65	36.28	40.91	45.54	52.85	63.32	73.80	84.27	D
E	23.25	27.49	31.73	35.98	43.22	52.82	62.42	72.02	28.08	32.32	36.56	40.81	48.05	57.65	67.25	76.85	E
F	22.82	26.77	30.73	34.69	41.30	50.25	59.20	68.16	28.12	32.07	36.03	39.99	46.60	55.55	64.50	73.46	F
G	22.51	26.36	30.22	34.08	41.27	49.99	58.72	67.45	27.48	31.33	35.19	39.05	46.24	54.96	63.69	72.42	G
H	21.97	25.53	29.09	32.65	39.21	47.27	55.33	63.39	27.36	30.92	34.48	38.04	44.60	52.66	60.72	68.78	H
I	21.57	24.85	28.13	31.41	38.51	45.93	53.35	60.77	26.92	30.20	33.48	36.76	43.86	51.28	58.70	66.12	I
J	22.10	25.27	28.43	31.60	38.09	45.25	52.42	59.58	28.27	31.44	34.60	37.77	44.26	51.42	58.59	65.75	J
K	22.35	25.32	28.28	31.25	37.71	44.43	51.14	57.86	29.10	32.07	35.03	38.00	44.46	51.18	57.89	64.61	K
L	21.71	24.19	26.67	29.15	36.56	42.17	47.77	53.38	28.33	30.81	33.29	35.77	43.18	48.79	54.39	60.00	L

TABLE 1, (CONTINUED), SHOWING COST OF STEAM POWER.

(17) The cost of the boilers is shown in column *i*, the prices including not only the original cost of the boilers proper, but the erection and connection of the same. This section also discusses at some length the desirability of duplicate valves and connections to insure the continuous operation of boilers where stoppages cannot be permitted.

(18) The prices on above basis have been fixed at $22 per commercial horse-power for the lower steam pressures and $25 for the higher pressures. These prices are believed sufficient to provide sectional boilers with settings and all attachments, and the writer expresses the belief that this class of boilers should be estimated for, even at somewhat increased first cost, from considerations of safety and reduction in repairs. The influence on the results due to difference in the prices of boilers is discussed later in connection with Table 2, which is not here reproduced.

(20) Column *h* shows the cost of engines erected and connected ready for operation. The writer speaks of the difficulty of obtaining these prices. Circulars were sent to different engine manufacturers and all kindly responded, but many did not make engines of 500 h. p. or of all the types; some gave very low prices which might not be sufficient for close specifications, others added various percentages. The cost of some steam plants complete were, however, accessible. Mr. Pearson, of the West End Railroad in Boston, gave prices checking well with the prices given for triple compound engines, and the prices of six complete plants of various sizes, using simple engines, were obtained from advance pages of a work in course of preparation by Messrs. T. C. Martin and W. H. Schlessinger, the average of which also checked the prices stated in the table, being a little lower on account of the type of boilers employed.

(23) Column *l* shows the amount in column *k* augmented 2½ per cent. for inspection and 6 per cent. for loss of interest during construction, incidental salaries, etc. These percentages are independent of architects commissions and are intended to cover the numerous incidental expenses due to starting a plant. The percentage will generally be insufficient rather than the contrary, except in cases where a plant is simply increased after the organization is established.

(24) An inspection of column *l* shows an unexpectedly small difference in the total cost of steam machinery of different types when everything is considered. It is a curious fact that steam machinery of fairly good economy shows the lowest first cost, the cost of the simpler machinery being higher on account of additional boilers, and that of the more economical machinery being higher on account of the higher cost of engines, etc.

LIGHTING BY PHOSPHORESCENT TUBES.[1]

Amongst the experimenters who have done much in a quiet and persistent way in the domain of extreme high-tension and vacuum tube research are Messrs. Pyke and Harris, who, together with Sir David Salomons, have carried out the practical utilization of phosphorescent tube lighting to a degree, which, if it cannot be said to solve the long-discussed problem, is yet attended with very suggestive and satisfactory results. At various Royal Society and other conversazioni displays of phosphorescent tube lighting of some extent have been made, and it is with interest that we have learnt particulars of vacuum-tube lighting for both theatres and private houses that have been carried out on the system thus brought forward. At the works in New Tothill street, Westminster, Mr. Pyke in conjunction with Sir David Salomons, has been carrying out a number of experiments in this interesting and enticing field of research. Quite a large glass-blowing laboratory is kept going for the production of all kinds of vacuum tubes—a very favorite form now adopted being that of a closed coil, or spiral of thin glass tube, between two small bulbs. This coil, when made phosphorescent, gives out a fairly brilliant, cool light, using, it is calculated, about one watt per foot of tube lighted.

The difficulty with these tubes is that when brilliantly phosphoresced they become heated, and there is trouble from the melting of the glass after some interval of use. A further difficulty has been the necessity for the use of condensers to properly light the tubes, and condensers are both frail and cumbrous. In any case the light is never very brilliant—not sufficiently so, for instance, to take the place of ordinary incandescent lamps, though for the lighting of conservatories, where a soft and moonlight effect is desired, the groups of phosphorescent tubes produce an admirable effect, and many houses are now having such "glow" lamps added to the other lighting.

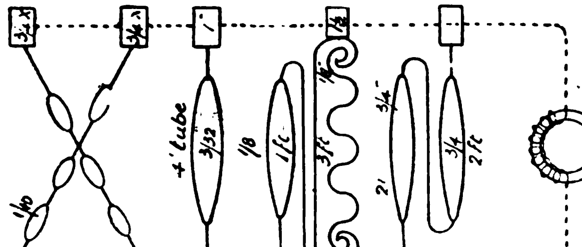

FIG. 1.

Before alluding to improvements that have recently been made in this class of lighting, it may be interesting to explain the principles upon which the lighting of these tubes has been carried out in experimental form.

An alternating current is, of course, necessary, and the inductor machine recently patented by Pyke and Harris is a very convenient form of dynamo to be used for private installations, being small, cheap and compact, though for town houses the alternate currents from the supply mains can be used.

To light the vacuum tubes, a tension of 50,000 or 100,000 volts is desired, and this is produced by a specially wound transformer in oil, of the type that Messrs. Pyke & Harris patented and have produced for some years. This transformer is plunged in dehydrated oil, which is kept in circulation by an arrangement of tubes like those in hot-water heaters. These transformers are expensive, and have been lately replaced by a different arrangement.

Having the current at high pressure, the next question is the arrangement most desirable in practice for connecting the tubes. The tubes are lighted by induction effects, and the peculiar arrangement of connecting the condensers in parallel and the tubes in series is here illustrated for the first time, Fig. 1. Mr. Pyke has made careful experiments, and finds that to properly phosphoresce tubes of one inch internal diameter one square foot of tinfoil condenser is required. To light tubes of one-sixteenth inch diameter, which have been generally employed, condenser sheets three-fourth inch square are therefore required to give the desired effect.

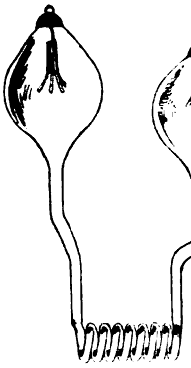

FIG. 3.

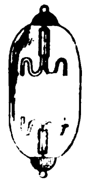

FIG. 4.

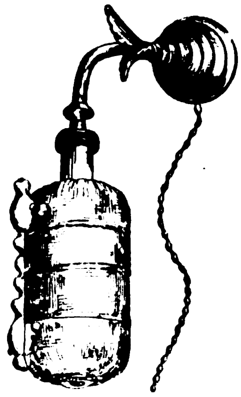

FIG. 2.

On one side of a glass plate a number of condenser sheets are arranged of the size desired, and these are all connected in parallel to the high-tension circuit, as shown by dotted lines on the figure, the dotted lines representing the under side of the sheet of glass. On the upper side the vacuum tubes are connected from one condenser plate to another, several in series, tubes of the same kind only on any wire, usually to make a total of one foot of tube. The whole of these tubes then light up on turning on the current, it being understood that they are lighted by induction condenser oscillations.

The following are the practical directions for vacuum tube work of this kind:

Directions.—Class the tubes in average minimum internal diameter. Arrange that each tube or series of tubes in the various circuits have the same length. Tubes in each class only must be worked in series. Imagine the tubes electrically connected, then arrange the inductors so that one square foot of foil (one-sixteenth glass) goes to each square inch of diameter. Above one inch, the current should be graduated more by the surface of the aluminium wire. Any difficulty may be overcome by cutting off one or adding to both inductors.

So far with the methods hitherto used, now to be discarded. The difficulties are apparent—special dynamo, expensive transformer, cumbrous condensers. Experiments have been made to do without the condensers, and to construct a small, but powerful transformer, which can be used direct. A small closed-circuit transformer has been designed by Sir David Salomons and Mr. Pyke for use in conjunction with the supply companies' alternating-current circuits, intended to raise the potential from 100 to 5,000 volts. This is probably the smallest closed-circuit transformer yet made, and is very cheap to make, as it is capable of being sold for £1 for ordinary and experimental use. The illustration, Fig. 2, shows it attached to ordinary 100-volt mains.

The quantity of current which it furnishes at this potential is sufficient to very brilliantly illuminate vacuum tubes. Indeed, so bright are they, that the photograph from which the above illustration is reproduced was taken solely by the light of the tubes suspended from the secondary terminals. The transformer, it will be seen, is provided with an attachment in the form of the usual "B. C." lampholder, the primary winding being connected to the brass contact-plates. This is a great convenience, as the connection is made, and the transformer securely held, in any conveniently placed lampholder.

The curled phosphorescent-tube lamp used in these experiments is here illustrated, Fig. 3. In practice the two bulbs are hidden, the glass spiral only being visible, and several of these lamps may be easily arranged to form letters or words. A newer form of uranium tube is also shown, Fig. 4, in which the electrodes are in the form of a spray. A large number of these tubes can be connected in series and lighted from the combination transformer.

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[1] London *Electrical Engineer.*

The transformers are made by winding three primary circuits of No. 22 wire—one at each end and one in the middle—over boxwood bobbins, with the secondary of No. 40 wire in between. The whole is then wound longitudinally over and over with fine iron wire till the central core is filled, making a small and solid bundle which can be suitably covered with velvet or other material. The vacuum tubes can be mounted thereon. One very convenient point is that, as they are furnished with an ordinary lampholder bayonet joint, current at 5,000, or perhaps even 10,000 volts will be within the reach of ordinary experimentalists at a mere nominal cost. The current going into these transformers is only one-half ampere at 100 volts, and the current at the higher voltage is therefore infinitesimal—not sufficient, in fact, to give more than a slight shock.

It will be evident that high-tension currents are now within the reach of all, and we may expect further developments in this fascinating field of phosphorescent tube lighting.

TITUSVILLE, PA., GIVING UP ITS MUNICIPAL PLANT.

THE city of Titusville, Pa., wants to give up its municipal lighting plant.[1] An electrical engineer, who passed through the city recently on business, writes us: "The citizens are kicking like steers at the wretched service they are getting. There was no light last night. I noticed that their pole lines are in an awful condition." These statements are borne out by the following item from the local *Herald:*

The following statement shows the cost to the city of the present electric light plant. The figures given are correct as they are taken from the books of Controller Harton, from Jan. 1, 1890, to April 6, 1891.

EXPENDITURES.

Fuel gas, $259.88; coal, $800; carbons, $482.72; wire, $161.53; lineman, $935.33	$2,639 46
Repairs, $150.05; armature, $275; supplies, $287.32; feed (for lineman's horse), $104.06	816 43
Labor, $65.80; globes, $39.85; illuminating gas, $226.25; oil, $29.71	411 62
Fifteen months' cost, controller's statement	$3,867 51

FROM APRIL 6, 1891, TO APRIL 4, 1892.

Coal, $930; carbons, $377.44; lineman, $720; repairs, $101.15; labor, $54	$2,182 59
Supplies, $228.38; feed, $103.72; wire, $109.72; cash, $35	479 09
Controller's statement, twelve months	$2,661 68

Wages received by engineers and firemen before and after the installation of the electric light plant as shown on the controller's books:

	Before. Per Day.	After. Per Day.	Increase. Per Day.
1st Engineer	$2 75	$3 75	50c
2d "	2 50	2 75	25c
1st Fireman	1 50	1 85	35c
2d "	1 50	1 85	35c
			$1 45

Cost from Jan. 1, 1890, to April 4, 1892, 824 days at $1.45	$1,194 80
Cost of operating plant 27 months	7,728 99
Interest on $8,923.77; cost of plant at per cent, 27 months	806 14
Depreciation by wear and tear, 6 per cent, 27 months	1,204 70
	$9,731 83
Cost per month to supply an average of 52 lights	360 44
Cost per light per month	6 93

The Electric Light and Power Company offer to furnish 52 lights at a cost of $312 per month or $6 per light per month.

From a careful study of the above figures it will be seen that the total cost per year of the present city plant is $4,325.28. The Titusville Electric Light and Power Company offers on the other hand to perform the same service, and in a much more satisfactory manner, at $312 per month for an average of 52 lamps, which is at the rate of $3,744 per year, a saving to the city, if they accept the proposition of the company, of $581.28. The item of 6 per cent depreciation, as shown in the above statement, is very moderate. While it may be an ample allowance on the boiler and engine, it will not cover the amount of wear and tear on the poles, etc. The first cost of the boilers and the wear and tear on the same are not included in the above figures. The $1.45 per day, being the increased wages of the employees at the water works, is figured as the cost of running the plant, not including the lineman. This should be increased to at least one-third of the total amount paid the two firemen and two engineers, or $3.25 per day.

These figures are the facts in the case and speak for themselves, and will bear the close perusal of every taxpayer.

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[1] See article in this issue by H. A. Foster, page 309.

LETTERS TO THE EDITOR.

SOME INTERESTING FARMER-WALLACE REMINISCENCES.

IN the numbers of THE ELECTRICAL ENGINEER for February 1, 8 and 15, I find a series of articles by Mr. William J. Hammer on the early labors of Mr. William Wallace in connection with the dynamo-electric machine. While Mr. Hammer's papers record many facts of great interest, they also contain a number of statements that scarcely seem to be warranted by other facts. As an electrician who was in the employ of Messrs. Wallace & Sons from July 7, 1875 to January 1, 1885, a period of nearly 10 years, and having now in my possession note-books containing the records of every dynamo-machine (except two) built by the firm during that period, I must beg leave to criticise some of Mr. Hammer's statements. Prior to entering the employ of Messrs. Wallace & Sons, I had been the assistant, for seven years, of Moses G. Farmer, and had in fact been quite intimate with that veteran electrician, since as long ago as 1852.

It is stated in the article of February 8, that "he (Wallace) was the first builder of dynamos in this country." * * * * * "On this page (p. 130) is shown the first dynamo built in this country" * * * * * "which machine was built by William Wallace in February, 1874."

By reference to my note-books, I find that prior to the date mentioned, I had sent more than 67 dynamo-machines which had been ordered for torpedo service by the United States Government, to the Torpedo Station at Newport, R. I., at which station Mr. Farmer was at that time engaged in the service of the government. Any one of these machines was capable of generating a greater current when turned by hand, than the Wallace machine of February, 1874, ever succeeded in doing, even when driven by power.

In the proceedings of the Literary and Philosophical Society, of Manchester (England), vol. vi., Sessions of 1866 and 1867, will be found the following record:

> "Mr. Wilde has also received a letter on the subject of his recent experiments in magnetism, from Mr. Moses G. Farmer, of Salem, Mass., United States, dated November 9, 1866, in which he says that he has obtained an increase of 31 p. c. in the power of a magneto-electro machine by transmitting the current from the armature through coils of wire surrounding pieces of soft iron forming the prolonged extremities of the permanent magnets of the machine" Mr. Farmer in the letter adds: "I have built a small machine in which a current from the thermo-battery excites the electromagnet of your machine to start it, and after the machine is in action a branch from the current of the magnets passes through its own electromagnet, and this supplies the magnetism required. It is not exactly like a person standing in a basket and trying to lift himself, because the electricity proceeds from the conversion of the mechanical energy, which must be continually supplied, neither can it be likened to the various schemes for producing perpetual motion, but depends on the principle, that the actual energy of the mechanical force, conjointly with the potential energy of the magnet, can develop a greater amount of potential energy than is originally resident in the magnet, or, in other words, it is a method of converting part of the actual energy of the prime mover into the potential energy of magnetism."

In reference to the historic machine known as the "Telemachon," Mr. Hammer says:—"Though I believe it never occurred to any one to try it as a motor transformer."—It certainly was sufficiently tried as a motor. During the Centennial Exhibition at Philadelphia in 1876, I was in charge of the entire exhibit of Messrs. Wallace & Sons, and can say that during the period of the exhibition, the "Telemachon" was run as a motor almost every day, but not even once as a light producing machine. The machine was placed intentionally with its pulleys at right angles to the main shaft. One of the wires from an electric light machine, concealed under the floor, was led to one terminal of the "Telemachon," and whenever a sufficient crowd of spectators had assembled, I was accustomed to take the other wire and put it on the remaining terminal, whereupon the armature of the machine would start off at the rate of 2,500 revolutions per minute, to the great amazement of the lookers-on. I never saw but one light produced from this machine at the works. On one occasion, when Mr. Farmer was there, he made measurements of its work, using a candle, placed at a distance of 100 feet from the arc, which gave a result of 15,900 c. p.

Mr. Hammer omits to make mention of one important item. I believe that the first measurement on record of an electric-light machine is one which I find mentioned in my note-book, under date of June 24, 1876, as follows:—

"Forenoon in Annex 3; Machinery Hall. We had a trial of Farmer and Gramme magneto-machines before the Judges."

This trial was conducted by Professor Henry of the Smithsonian Institution, and among those present were Sir William Thomson, the French commissioner, Professors Bell, Draper, Barker, and some 50 other more or less distinguished persons. This trial ended in a somewhat peculiar way. During the day, measurements had been made of the power absorbed by the machines, and it had been arranged that the power of the light produced should be measured the same evening, but when evening came, lo! the French machine had disappeared; it had gone back to its own space, and no explanation of the proceeding was vouchsafed.

I also had charge of the exhibit of Wallace & Sons in Boston in 1878, and here, as I believe, Mr. Wallace showed for the first time in public, arc-lamps run in series. At the same time Mr. Brush exhibited two machines, each supplying four lights, and having separate wires from the machine to each lamp. Wallace & Sons made during that year several important displays of arc-lamps; one was at the Mechanics' Fair on Columbus avenue in Boston; one at the American Institute Fair in New York, and another at the Maryland Institute in Baltimore; exhibitions which must have cost in the aggregate, many thousands of dollars.

I do not believe that any man in this country except Mr. William Wallace would have had the courage to expend such a vast sum of money as was required in order to install that immense plant for the manufacture of compound wire for telegraph lines, which is referred to and partially illustrated in THE ELECTRICAL ENGINEER of February 15. And it is my opinion that if that telegraphic system had been successfully established (and it was no fault of Mr. Wallace that it was not), we should be doing all our telegraphing to-day at a cost of about ten cents for fifty words to any point within the limits of the United States.

CHARLES STOWELL,
Electrician.

DIRECT COUPLED ISOLATED PLANTS.

I NOTICE that in your paper of this week's issue, in an article on the electric lighting plant installed in the Havemeyer Building, you stated that the plant was the first of its type in this country.

I therefore wish to bring to your notice that Messrs. Thos. H. Dallett & Co., of Philadelphia, Pa., the manufacturers of the Billberg dynamos, with the assistance of Messrs. McLeod, Ward & Co., of this city, installed in the new factory of the New York Biscuit Co., a plant, such as described, a year ago, consisting of a 95,000 watt dynamo of the Billberg type, and an Armington & Sims double engine, coupled directly together by means of a flexible coupling of their own manufacture. This plant has been running for the past year, and has given perfect satisfaction, so much so in fact, that a second plant of 900-light capacity was ordered a few months after starting of the original plant.

NEWTON L. SCHLOSS.

NEW YORK CITY, March 23, 1893.

WHAT CONSTITUTES A TRANSFORMER?

IN your issue of March 15, p. 262, Mr. Horry writes as follows of a new Heisler induction coil:

"This device is supplied from the street mains with five amperes. The secondary winding is substantially the same and provides a five ampere current. *For this reason it is not a transformer at all,* nor * * * . It transforms neither up nor down; it generates a new current precisely similar to the first, and it keeps the high potential out of the house."

If an induction coil which "keeps the high potential out of the house" by yielding a five ampere low tension (?) current at the lamps from a high potential five ampere shunt main "is not a transformer at all," will Mr. Horry oblige us with the proper definition of "a transformer that *is* a transformer *at all*"; and why he calls a non-reducing induction coil a "a reduction box"?

J. STANFORD BROWN.

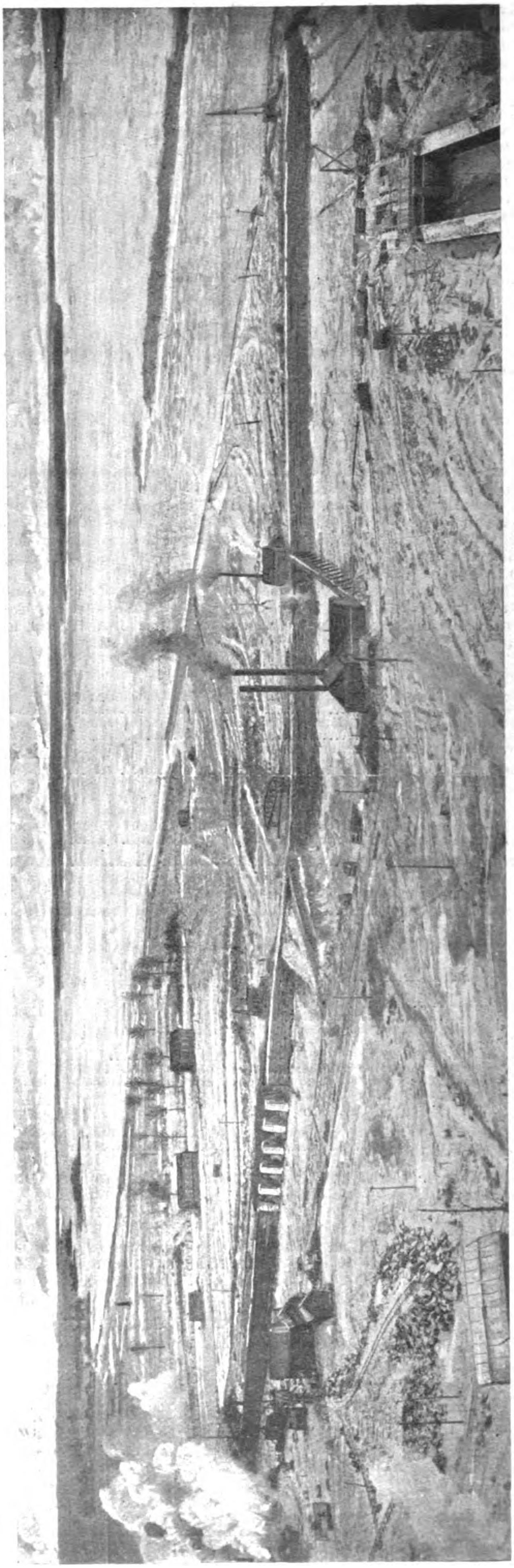
NEW YORK, March 20, 1893.

COMMERCIAL CABLE COMPANY.

THE annual meeting of stockholders in the Commercial Cable Company was held last week and the following directors were re-elected: J. G. Bennett, A. B. Chandler, G. S. Coe, C. R. Hosmer, G. G. Howland, R. Irvin, Jr., J. W. Mackay, J. W. Mackay, Jr., E. C. Platt, T. Skinner, Sir A. D. Smith, W. C. Van Horne, and G. G. Ward. The annual report stated that the gross earnings for the year 1892 amounted to $1,890,377, and the net revenue showed an increase of $14,263 as compared with the year 1891. Quarterly dividends of 1¾ per cent. each have been paid, absorbing $540,120, and debenture bonds to the amount of $600,000 were redeemed on Jan. 15 last, thereby reducing the total amount of bonds outstanding to $80,000. In order to provide for the laying down of a third cable it has been decided to offer to the shareholders, for subscription at par, 19,290 shares out of the 22,840 shares now unissued. Each shareholder will be entitled to subscribe for one share for every four shares he holds.

WESTERN UNION OPERATORS.

IT has been charged lately that the Western Union Telegraph Company has discriminated against members of the Order of Commercial Telegraphers. This is denied, but there has been considerable friction between the various authorities. The Western Union officials say there is no likelihood of a strike.



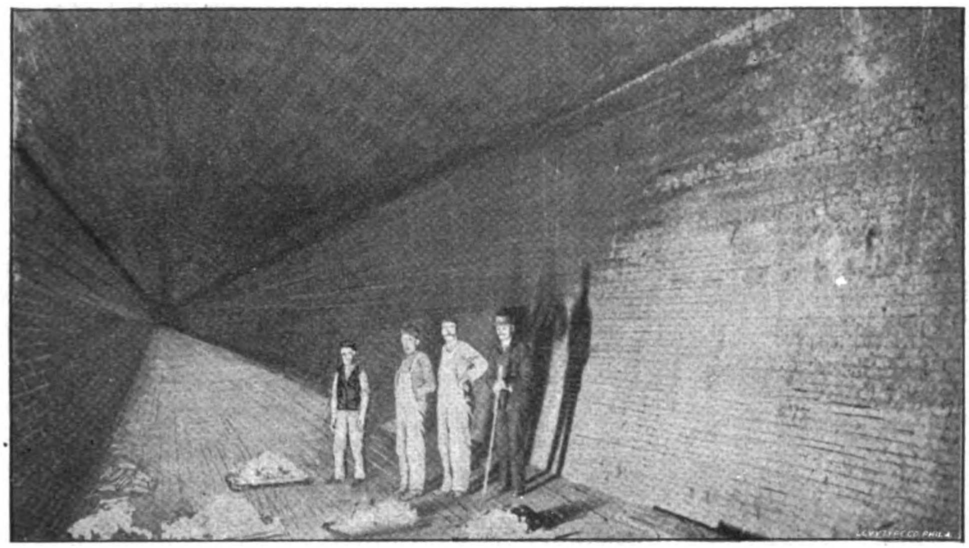
GENERAL VIEW OF THE HARBOR AND INTAKE WORKS, NIAGARA FALLS POWER CO.

THE FUTURE CITY OF NIAGARA FALLS.

In view of the excellent series of articles by Prof. George Forbes, so recently published in The Electrical Engineer, on the transmission of power at Niagara Falls, it is unnecessary to dwell at greater length on that part of the subject. There is, however, another point from which it may be regarded; that of the enormously enhanced value of the property in the immediate vicinity of the works.

The Niagara Falls Power Company after having purchased sufficient lands for its great undertaking, began near the head of the rapids on the American side and bought thence the entire river bank up the stream for a distance of over 2¼ miles; then inland and at right angles to the river, acquiring an additional tract of land, three miles long by nearly one mile wide, The land of the company is in the form of a reversed and inverted letter L, contains some 2,000 acres, and is contiguous to the old village of Niagara Falls. This land is to be used as sites for factories, the location of the power houses of the company, and dwellings for the thousands of workmen who will labor in the great mills. It equals in extent and area all the land in New York city lying between the Battery and Union Square and bounded by the East and North Rivers. The illustration on the opposite page shows a general view of the company's property.

This broad tract has been gridironed with a steam railway, built and owned by the power company. It taps all the trunk lines which centre at the falls, and runs to the docks on the river bank. The engines will receive freight cars from each connecting road and haul them to the factories to be built on the land. Along the edge of the river, docks of several thousand feet in length are being built, making water transporation directly to all points on the great lakes more easily available even than that at Buffalo.


The Great Hydraulic Tunnel, Niagara Falls.

Another large tract of this land is set apart for the erection of dwellings for mechanics, which will be erected by the company, and peopled by those whose daily duties take them to the great mills. The railway of the company will convey the operatives from their houses to the shops, while trolley cars even now running through the adjacent streets, will furnish further accommodations.

An interior view of the tunnel for carrying off the waste water from the wheel pits is shown in our second illustration. This is 19 x 21 feet in section and extends from the bottom of the pits to the water level below the falls. It is the intention of the company to run other tunnels parallel with this when circumstances demand more than 100,000 h. p., the amount the present plant is capable of developing. It is said that at Buffalo, Rochester, and adjacent towns, power, generated by steam costs from $35 to $40 per horse power per year of 10 hour days, while the water at Niagara will furnish this power for about $15 per horse power per year of 24 hour days. It would certainly seem that this is sufficient inducement to attract manufacturers and that the rosy hopes of the company are well founded.

We are indebted to Messrs. Granger & Paine, of 86 Falls street, Niagara Falls, N. Y., for the excellent engravings accompanying this article. These were selected from an interesting pamphlet entitled "The Great Tunnel," published by these gentlemen and containing much valuable information in regard to the falls from a scientific as well as a commercial standpoint.

LITERATURE.

Absolute Measurements in Electricity and Magnetism. Vol. II. Parts I and II. *New York*, Macmillan Pub. Co., 1893. XXIII + 868 pp. 5 x 7½ inches. Price, $6.25.

The two parts of the volume before us complete what will be generally conceded to be the most comprehensive work of its kind in the language. The author, while giving the theory of absolute measurements in electricity and magnetism as complete as space would allow, has striven as far as possible to show also the application of the theories to practice, and the result is a coordination which cannot but be of the greatest value to all students and electrical engineers, and particularly those who have the facilities of a laboratory at hand.

The author, in the present volumes, takes up first the magnetic theory, treating of magnets, the potential energy of the magnetic induction, etc. This is followed by the study of the theory of electro-magnetic action, the action between magnets and currents, and currents on currents. In these days when the influence of the medium in the propagation and maintenance of electrical and luminous phenomena is forcing itself upon the attention of experimenters, the chapter on the electro-static energy of the medium is of special value; the author has also introduced the latest discoveries of Hertz on electrical radiation.

Part 2 will probably be considered by many as of the most immediate value, since it is devoted more exclusively to the description and discussion of galvanometry and the measurement of currents. The author takes each instrument, such as the tangent and sine galvanometer, describes its construction, winding, adjustment, etc., and the method of using it, in order to obtain the best results. We also find sections devoted to the measurement of currents, and the graduating of instruments by electrolysis, showing the latest methods, and also the determination of the E. M. F. of voltaic cells and the graduation of voltameters.

The widespread use of the alternating current and the large amount of experimental work which is being carried on in this field at the present makes it desirable to have a concise record of the best methods in measuring inductances, and the author has brought together in this part an excellent collection of the standard methods proposed and many which have come into use in general laboratory work. Chapters are also devoted to the measurement of activity in electric circuits, to units, etc., and we also note that the author has given special attention to electric oscillations and radiations, giving the results of the theory and experiments of Hertz and others in this new field.

In this necessarily brief review we have been able to convey to the reader but a faint idea of the enormous task accomplished by Prof. Gray, and carried out in the most painstaking manner. The student is throughout guided by marginal paragraph captions and numerous references to original sources of information.

Lignes et Transmission Electriques. By Lazare Weiller & Henry Vivarez. *Paris*, G. Masson, 1892. 828 pp. 6½ x 10 inches. Price, $5.

The authors have taken for the subject of their work, a branch, which, in these days of 1,000 h. p. dynamos is very apt to be neglected, but which nevertheless is essential to the success of an electrical plant of whatever nature it may be. In the volume before us the authors begin by treating in general the problem of conveying the electric current, and the study of the manufacture of metallic wires, showing the methods now in most general use, and following this by details on the electric conductivity, on the use of copper and bronze wires, and other single metallic and compound wires.

They then take up electrical insulators showing what the requirements of a good insulator are, and describing the various types of insulators now in general use, including not only those required for telephone and telegraph lines, but also for electric light both overhead and underground.

Wooden poles form the subject matter of three chapters in which the authors enter into a minute discussion of the methods of preservation, both those suggested and practiced in the past and those in vogue at the present time. These are followed by several chapters on metallic poles and supports for wires, in which we find descriptions of a number of excellent designs.

The survey for running an electric line is next taken up, and rules for the most economical route are laid down. To these portions are added chapters on other details of construction, such as the erection of the wire, making of joints, and special directions for telegraph and telephone wires. This part of the work also contains descriptions of the latest methods for the erection and operation of lines intended for transmitting power at high voltage for long distances.

Underground and submarine cables form the subject matter of a number of chapters in which the manufacture and testing of insulated cables of various kinds are thoroughly treated. The authors have also entered very minutely into submarine telegraphy, giving very full accounts of the methods of construction and operation of submarine telegraph cables, their laying, repair, etc.

Chapters on the measurement and localizing of faults in electric conductors are added, and we note also a chapter on the construction of trolley wires. In this chapter the authors have scarcely availed themselves of good material which could have been easily obtained.

Chapters each on lightning arresters and electric bells, etc., and a number of rules and regulations for the stringing of wires, electric lighting, etc., in vogue abroad bring the work to a close.

When we say that the work before us is devoted to European—more particularly to French practice—we do not wish to detract in any way from its value; on the contrary, the study of the methods will, we are certain, be of value to American electrical engineers, who will find here many ideas well worth adopting. The work is most profusely illustrated, and is got up in the most creditable manner.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED MARCH 14, 1893.

Conductors, Conduits and Insulators:—

Insulator Pin, F. M. Locke, Victor, N. Y., 493,434. Filed Sept. 29, 1892.

An insulator pin having a base with a central opening, an insulating sleeve mounted thereon, and a bolt connecting them with the cross-arm and with one another.

Dynamos and Motors:—

Dynamo-Electric Machine, E. Thomson, Swampscott, Mass., 493,313. Filed July 28, 1891.

Claim 1 follows:

A rotary portion in a dynamo electric machine, comprising a laminated ring having notches in its periphery, laminated core sections inserted in said notches and coils wound around or between said sections.

Armature for Dynamo-Electric Machine, H. F. Parshall, Lynn, Mass., 493,337. Filed Sept. 15, 1892.

Consists of an annular core surrounding an internal concentric support und keys between the support and the core preventing an independent movement of either.

Armature for Motor and Generators, N. C. Bassett, Lynn, Mass., 493,349. Filed July 9, 1891.

An armature core having grooves near its surface with tapering sides, coils wound in the grooves, followers placed on the coils and binding pieces driven into the grooves.

Balanced Armature for Dynamo-Electric Machines or Electric Motors and Method of Balancing Same, G. S. Dunn, New York, N. Y., 493,375. Filed June 6, 1892.

An armature having holes bored at various points near its circumference within which pieces of lead are adapted to be placed.

Electric Motor for Dental Work, J. Keller, Canton, O., 493,431. Filed June 6, 1890.

Commutator for Dynamo Electric Machines and Method of Constructing Same, A. W. Meston, St. Louis, Mo., 493,439. Filed Sept. 12, 1892.

Consists of an annular supporting plate having on one side face an annular groove, and a segmental contact ring secured on the groove and insulated from the supporting plate.

Armature Connection for Dynamo Electric Machines, G. A. Rollinson, Chicago, Ill., 493,477. Filed Feb. 16, 1892.

Claims 2 follows:

In a dynamo-electric machine the combination of an armature with coils and wires which are led off therefrom to commutator segment strips, each of said wires sharply bent into a short curve at some point along its course from the armature to the strip, said bend being away from the general course of such wire in passing from armature to strip.

Heating:—

Electrically Heated Vessel, J. V. Capek, New York, N. Y., 493,422. Filed Dec. 14, 1891.

Lamps and Appurtenances:—

Electric Search Light, R. M. Hunter, Philadelphia, Pa., 493,358. Filed Sept. 16, 1891.

A lamp and reflector so supported as to have universal movement in every direction; the beam of light being vibrated so as to cover a large area and at the same time produce the effect of being focused upon every point within such area.

Electric Arc Lamp, R. M. Hunter, Philadelphia, Pa., 493,359. Filed Sept. 1, 1892.

Has for its object to produce a large crater upon the end of the horizontal or reflecting carbon, and emplys for this purpose a plurality of vertical carbons.

Electric Arc Lamp, R. M. Hunter, Philadelphia, Pa., 493,360. Filed Oct. 14, 1892.

The lamp is supported upon the outer end of a supporting arm while the regulating mechanism is fixed upon the base of the pole carrying the arm, and, consequently, at a considerable distance from the lamp.

Base for Electric Light Brackets, J. T. Robb, Mt. Vernon, N. Y., 493,411. Filed Feb. 24, 1891.

Support for Electric Lamps, J. R. Protzman, Streator, Ill., 493,446. Filed Sept. 17, 1891.

Electric Lamp Supporter, A. G. DeWitt, Detroit, Mich., 493,578. Filed Feb. 7, 1891.

Lamp Socket, H. B. Ball & A. Metzger, Schenectady, N. Y., 493,609. Filed Aug. 3, 1892.

Employs a screw threaded sleeve for receiving the neck of the lamp, consisting of a helically wound wire.

Miscellaneous:—

Method of Electro-Depositing Metals, O. Lugo, New York, N. Y., 493,277. Filed Jan. 8, 1892.

Consists in depositing a metal from a liquid electrolyte, composed of a mixture of one or more soluble salts of the metal with water, by passing a current through it.

Personal Equation Chronograph, L. deL. Wells, London, Eng., 493,346. Filed June 17, 1892.

An electric device for recording the interval of time elapsing between the reception of an impression on the retina of the eye and the ultimate effect conveyed by the action of the brain to any desired part of the body.

Safety Device for Elevator Shafts, A. D. Caywood, Chicago, Ill., 493,423 Filed Aug. 29, 1892.

Telethermometer, L. S. Norton and F. E. Hoffman, Alpena, Mich., 493,558. Filed Oct. 31, 1892.

Railways and Appliances:—

Electric Locomotive, T. A. Edison, Llewellyn Park, N. J., 493,425. Filed Jan. 19, 1891.

Employs a magnetic clutch between the motor shaft and the axles of the vehicle, a shunt around the clutch independent of the motor branch and a switch for varying the resistance of the shunt.

Electric Railway Conduit and Contact, J. Davis and R. M. Huntington, Denver, Col., 493,618. Filed Oct. 2, 1892.

A conduit system arranged especially with a view to utilising the conduits now employed for cable railways.

Electric Railway System, T. Harris, Detroit, Mich., 493,623. Filed Jan. 8. 1892.

Employs a discontinnous working conductor, the sections of which are connected successively by automatic switching devices with the main conductor in such a manner that the sections of the working conductor are energized only while the car is passing.

Switches and Cut-Outs:—

Electric Switch, W. F. Bossert, Utica, N. Y., 493,243. Filed Feb. 17, 1892.

Employs a switch disc, and operating lever having an opening with cam faces, a pin from the disc projecting into the opening and a spring connecting the lever and disc.

Multiple Terminal Cut-Out, L. P. Bonebrake, Maryville, Mo., 493,323. Filed Nov. 10, 1892.

Consists of a series of contact levers pivoted in a circular line and held in position by pins and fusible wires, the latter connecting with the main line, in combination with a spring-acting circuit closer pivoted concentrically with the contact levers.

Switch for Electric Motors, M. Immisch, London, Eng., 493,361. Filed Nov. 21, 1891.

Emyloys switch levers and locking devices for preventing adjustment of the switch levers under certain conditions, a stop in the path of the make-and-break lever and a resistance lever adapted to engage the stop.

Electric Switch, A. Stromberg, Chicago, Ill. 93,369. Filed Nov. 1, 1892.

A switch for use in connection with burglar alarm systems.

Combined Cut-Out and Lightning Arrester, E. F. Hammerstrom, Stockholm, Sweden, 493,380. Filed June 3, 1892.

Employs an expansible open ring placed in the main line in such a manner that its ends will separate under an abnormal current and release a spring, thus opening the circuit.

Electric Switch, A. M. Coyle, Baltimore, Md., 493,485. Filed Mar. 3, 1892.

Consists of a movable part carrying spring contacts over a series of terminal plates carrying resistances in such a manner that as the switch is moved from its position in either direction it first makes contacts between the main line and the motor and all the resistances, and as it progresses cuts out the resistances seriatim.

Thermostat, T. W. Shepherd, Peabody, Mass., 493.601. Filed Aug. 6, 1891.

Electric Controlling Device, T. W. Shepherd, Peabody, Mass., 493,602. Filed Oct. 24, 1891.

A main contact arm moving between two fixed contacts is provided with an auxiliary contact arm moving between two other fixed auxiliary contacts independent of the main contacts; the auxiliary arm being flexibly connected with the main arm that their movement may be either in unison or independent of one another as the circumstances may require.

Telegraphs:—

Signaling Telegraph, W. E. Decrow, Boston, Mass., 493,253. Filed Nov. 14, 1892.

Provides means for automatically recording on the register strip the time when the signal is received at the central station.

Telegraph-Relay, S. P. Freir, East Orange, N. J., 493,620. Filed Dec. 15, 1891.

Telephones and Apparatus:—

Ear Attachment for Telephones, G. McC. Brown, Nashville, Tenn., 493,245. Filed June 23, 1892.

ANOTHER TOURNAMENT OF TELEGRAPHERS.

A VERY interesting telegraphic tournament was held last Saturday at Hardman Hall, this city, when operators from all over the country competed, in the presence of hundreds of their brethren and sisters of the key, for a number of handsome money prizes and medals given by Walter P. Phillips, John W. Mackay, Postal Telegraph Co., and others. There was a rattling competition for the championship of the world, for the best sending on a five minutes' stretch. The prize was awarded to F. J. Kihm, for 248 words of the best Morse. He was closely pressed by F. J. Catlin, who sent exactly the same number in a style so little inferior that it seemed like hair-splitting to make him second. Both men have competed before. The prize was $100 and a gold medal. Owing to the length of the tournament, and the time necessary for making a decision, the full list of awards was not furnished at the time of our going to press on Monday.

ELECTRIC MOTORS OPERATING ON SINGLE PHASE ALTERNATING CURRENT CIRCUITS.

BY

Elias E. Ries & Gordon J. Scott

IN view of the discussion that has recently taken place in reference to alternating current motors, both on this and the other side of the water, we desire to announce through the columns of THE ELECTRICAL ENGINEER, that for the last year and and a half we have given a great deal of attention to the question of power transmission by the use of the commercial alternating circuits now in use. The subject has been dealt with on circuits, the frequency of which varied all the way from 40 to 200 cycles per second. Some very interesting and useful facts have come to light, and our experiments have shown that practical alternating current motors of any size can be built and operated at the ordinary frequency of 138 cycles per second, or even at higher frequencies, with a commercial efficiency equal to any direct current motor.

This has been fully demonstrated by experiments made upon a motor in the factory of the Ries Electric Specialty Company, which develops nearly two horse-power at the slow speed of 360 revolutions per minute. The total weight of this motor is just 64 pounds; there are only two pounds of copper on the machine, and it shows a commercial efficiency of 85 per cent. when run upon an ordinary incandescent lighting circuit of 50 volts, at a frequency of 138 cycles per second.

The motor referred to is built upon entirely new lines, and is radically different from any of the types of alternating motors so far described. The motor operates without the use of condensers, reaction devices, secondary batteries, or similar paraphernalia for changing the lag or phase. We intend to turn out in a short time, in addition to this type, an entirely new and novel single phase motor of high efficiency, having a completely closed magnetic circuit, and as a consequence a very small magnetizing force.

For electric railway work, we have a special form of this motor under way, which will have a variable speed with maximum torque, a feature that has not heretofore been possible either with direct or alternating current motors, although numerous attempts have been made by various well-known inventors to produce this desirable result in direct current practice, by the use of motor generators, differential gearing, and other equally complicated devices. The Ries and Scott railway motor of this type will be of 20 h. p., and will weigh, when completed, about 600 pounds, which is less than one-half of the weight of direct current railway motors, thus combining great starting effort with low consumption of energy and with very light weight.

Owing to patents pending, we cannot enter into fuller details at present, but can state that we will in a few months, place upon the market a reliable self-starting, synchronous or non-synchronous alternating current motor, fully equal, if not superior, to any direct current motor that has been built. This motor will not only solve the difficulty that has thus far been encountered in utilizing single phase alternating currents for operating stationary motors of all powers, but will also render it commercially possible to employ the alternating current for electric railway work on a scale that will render the system, for economy in transmission and regulation, to say nothing of increased safety and freedom from repairs, far superior to the direct current electric railway practice of to-day.

A GRACEFUL AND GENEROUS ACT.

AT a recent meeting, the Crocker-Wheeler Electric Company, recognizing the faithful work of their late manager, Mr. Jeffery, voted a whole year's salary as a gratuity for past services. Mr. Jeffery's family will be the beneficiaries of this generous act, which reflects the greatest credit upon the company, and cannot be commended too highly.

THE ELGIN ELECTRIC CLUB.

THE Elgin Electric Club, of Elgin, Ill., has been organized with the following officers: president, Fred'k Purdy; vice-president, Dr. G. L. Marion; secretary, J. Frank North; treasurer, Henry Klinder; librarian, R. W. Pinkerton. Its membership already numbers 48 and applications are constantly coming in.

"NOT BY BREAD ALONE."

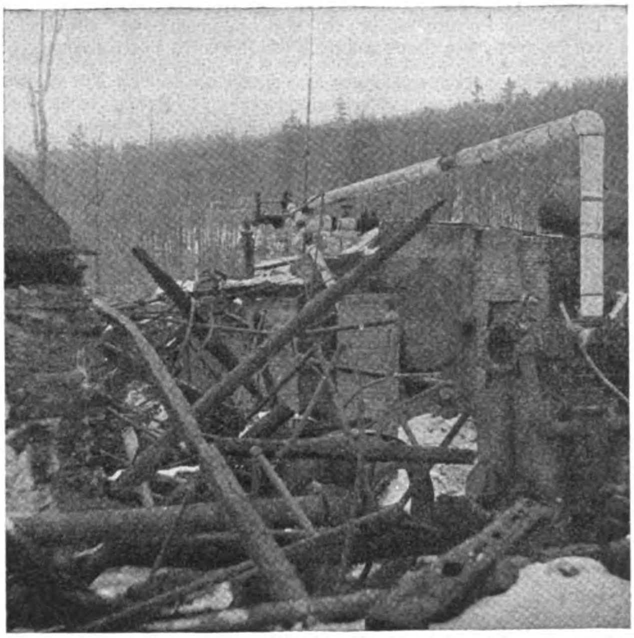
ONE of our Western reader in renewing his subscription to THE ELECTRICAL ENGINEER writes: "I believe I could do without my victuals for one week rather than miss one of your numbers."

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

AN INTERESTING TEST OF MAGNESIA SECTIONAL COVERING.

WE have had occasion frequently to point out to our readers the value of using a fire-proof covering on the steam pipes used in connection with electric lighting or power plants, as forming quite as important a feature of economy in practice, as does careful attention to the strictly electrical features, to even the selection of a boiler, engine or dynamo. We have also in describing numerous central stations had frequent opportunity to refer to Magnesia Sectional Covering for this purpose, and we illustrate in the accompanying engraving, an interesting picture taken from a photograph, showing the wonderful fire-resisting properties which this material possesses. The photograph was taken from the ruins of the A. W. Eaton Paper Company's mill at Lee, Mass., which was burned to the ground a few weeks ago, everything being utterly destroyed, except the line of steam pipe, so clearly shown in the engraving, in a perfect state of preservation, which was covered with the magnesia covering. The pipe shown in this photograph as covered with the Magnesia, is unharmed and can be reused. This was the case after the great Lynn fire of a few years ago. Probably the Magnesia Covering itself can be reapplied to the same pipe after the changes have been made.



MAGNESIA COVERING AFTER A FIRE.

It is a peculiar feature of the Magnesia Covering that it seems to be well-nigh indestructible, not only indestructible in itself, but as a covering, so that whatever changes are made in a steam plant, or through whatever vicissitudes the plant may pass, the magnesia covering still preserves its value as a covering, and that value, as determined by the exhaustive tests of the Boston Manufacturers' Mutual Fire Insurance Co., is greater than that of any other indestructible substance.

The use of this material both as an insulator of heated surfaces for the prevention of loss of heat by radiation, and also as a fire-proofing material, has grown from the time of its introduction, in 1886, to very large proportions, and in every case expectations based upon it have been fully borne out by the results.

When the steamship, "Henry M. Whitney," went to the bottom of Boston harbor last year, her boilers, etc., were covered with magnesia covering. After she was raised and the boilers were taken out, the covering was stripped off and saved, and after the repairs in her machinery had been completed, all the covering which had been taken off was reapplied.

The magnesia covering has been in use at the power stations of the West End Street Railway Company since their beginning, and the covering which was formerly applied to the temporary plant was taken off and reapplied to the permanent plant.

This covering is being placed in almost all of the new first-class buildings. The new Public Library Building, Boston, the

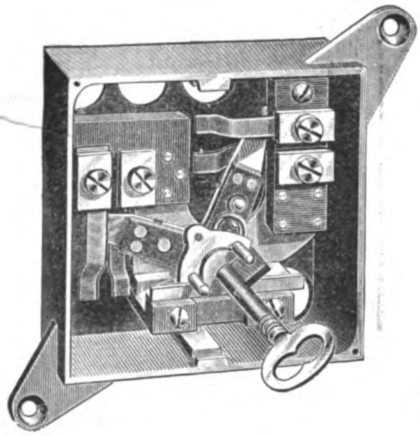
Institute of Technology, the buildings of Harvard College, the new Walker Building, and others. In State public buildings, particularly buildings like insane asylums, houses of correction, and the like, is the magnesia peculiarly desirable because it is not only effective as a non-conductor of heat, but it is without odor, and affords no refuge or harboring place for vermin. For fire-proofing iron columns it is peculiarly valuable because it can be thoroughly and securely applied, and so perfectly resists the action of heat and of fire.

THE MOORE REGULATING LAMP SOCKET.

THE ingenious regulating lamp socket which is described by the inventor on 308 of this issue appears likely to attain great popularity on account of its simplicity and cheapness. As it obviates the use of all dead resistance, the saving in current is appreciable and as the filament is still visible in the dark when $\frac{1}{100}$ of an ampere is passing through the lamp the expense of running a night light is insignificant. The patents for this device have just been issued and are owned jointly by the inventor, Mr. D. F. McFarland Moore, of this city, and Mr. Edward J. Wessels, of Westfield, N. J., now of the Curtis Electric Manufacturing Company.

THE "C. S." FLUSH KEY SWITCH.

AMONG the electrical specialties recently introduced by the Cutter Electrical and Manufacturing Company of Philadelphia is the flush key switch shown in the accompanying illustration. As will be seen, the mechanism is enclosed in, but thoroughly insulated from, an iron case, and covered by a face plate having a key-hole through which alone access can be had to the interior. The break is instantaneous and the terminal brushes for both main and lamp circuits are 1½ inches apart. The cover of the case is locked on and cannot be removed without its special key.



THE "C. S." FLUSH KEY SWITCH.

The catalogue of the company recently issued contains descriptions and illustrations of a quantity of interesting electrical apparatus.

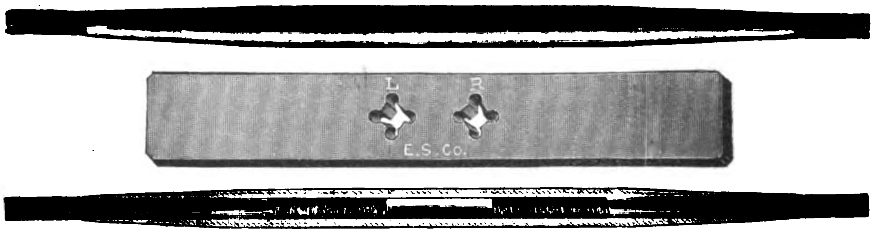
PREPARING THE "KERITE" WORLD'S FAIR EXHIBIT.

THE following is from the Ansonia, Conn., *Sentinel*, in its Seymour news, and gives an interesting account of the Kerite World's Fair exhibit:

> Looking upon a World's Fair trip as a luxury quite beyond the range of reportorial experience, a *Sentinel* man took advantage of an opportunity to view a portion of it, this morning, and paid a visit to W. R. Brixey's insulated cable factory on Dey street, where an exhibit of the famous "Kerite" cables is being prepared. A temporary structure about 40 feet square has been erected back of Mr. Brixey's residence, and a force of men is busily engaged in putting the exhibit in shape. Mr. Brixey was giving the work his personal supervision and readily consented to give the details of the excellent plan which he is carrying out.
>
> His space is finely located at the head of the main stairway in the electrical building, and it is 28 x 40 in size. It is to be enclosed with heavy brass railing in the form of a cable, and just inside the railing will stand handsome cabinet show cases with plate glass windows, in which will be placed various parts of the output of the factory. About the enclosure will be 50 large spools made of white ash finished in its natural state, and wound with all sizes and kinds of submarine, underground and aerial cables, which form the greater part of the work turned out. An attractive and excellent feature of the exhibit will be a cozy parlor in the centre of the space. Just in the centre is a post, and around this will be built a room 10 x 12 feet. The interior is of beautifully grained sycamore in its natural state, and handsomely carved. Running from the post to each corner are arches of the same wood, and filled with spindle work.
>
> The post itself is to be enclosed in sycamore boxing and from the arches will be suspended incandescent lights while about the space on the outside will be several arc lights. This little parlor is to be handsomely furnished and provided with many comforts which will be greatly appreciated by Mr. Brixey's friends when they call while at the fair. The exterior of the parlor and the cabinets is to be finished in white and gold and the general effect will be very pretty. Mr. Brixey will be at the fair himself when his business will enable him to do so, but he has not as yet given the exhibit in charge of any one. When it has been set up here and everything has been got into good shape, it will be taken down and shipped to Chicago to be re-erected there, and finished and furnished. The woodwork, which is very handsome all through, is from Tracy Bros., of Waterbury.
>
> After showing the exhibit and courteously answering many questions, Mr. Brixey conducted the *Sentinel* man through his recently enlarged and greatly improved plant. Entering through the new addition on the front, in which is a large, well-lighted room, to be filled with machines, and passing through the mill, he showed in a back room two 100-conductor underground cables which are to be shipped to the Western Union Telegraph Company at Chicago. Each weighs about three tons and is 3,000 feet in length. Another large submarine cable, 18 conductor, lies waiting for its wire armor before being ready for laying across the North river at New York. The new engine room was next visited and a mammoth Green engine inspected, the 125-horse-power of which it is capable being held in reserve for a failure of the water supply. In a room near by are two mammoth boilers of the water tube variety and with a developing power of 155 horse power.
>
> Just across a private road, and on the bank of the stream is the private electric light station fitted with a dynamo and run by a turbine wheel or a dandy little New York Safety engine when the water is low. The interior of the station is finished in natural woods and the floor covered with matting. Here, as is the case all over the mill, cleanliness reigns supreme as far as the work will allow. Mr. Brixey says that when spring comes the grounds about the mill, which have always been pretty, will again be laid out and sown with grass and the general air of thrift will be retained.
>
> During his régime as superintendent and lately as proprietor of the concern, it has seen many changes, all looking toward the betterment of its facilities and appearances and are all indications of the progressive nature of the owner, whose push in putting the "Kerite" in the front rank of insulated cables, as demonstrated by the increased output, is only equaled by his energy in keeping up with the demand. The concern is a credit to the town.

WOOD'S TROLLEY SPLICER.

THE accompanying illustration shows the splicing tube manufactured by the Ansonia Electric Company (formerly the Electrical Supply Company), of Chicago. The connector is made in one piece, threaded on the inside with a right and left hand thread. With the aid of a threading tool, furnished for threading the wire, this splicer can be adjusted to the trolley wire in a very few minutes. These trolley splicers have been in use for more than a year, and have been endorsed by all electric roads using them. The splicer can be furnished with slots cut in it to admit of soldering, but this is not necessary, as the breaking strain without the use of the solder is 8,000 pounds; with the addition of the solder it will stand a strain of 4,550 pounds without affecting the threads inside. This test was made by the Chicago City Railway Company, the strain having broken the trolley wire without doing any damage to the splicer, or even stripping a thread. They constitute, practically, a continuous wire, and cause no sparking or flashing as the trolley wheel passes. The Ansonia Electric Company are manufacturing them in large quantities and find them great favorites with electric railway men.



WOOD'S TROLLEY SPLICER.

"VULCANIZED MUD."

THE DELAWARE HARD FIBRE Co., of Wilmington, Del., has just issued a card calling the attention of electrical manufacturers to the fact that the low prices which prevail for fibre have tempted some manufacturers of that material to introduce impurities in their goods. They state that this can be done in the same way that rubber goods are adulterated. In samples which they have recently examined they found large percentages of red clay and chloride of zinc and calcium. In one case nearly 50 per cent. by weight of the "Fibre" was composed of these impurities.

The presence of such ingredients makes the fibre brittle, easily split and causes it to swell and shrink under atmospheric changes, besides utterly destroying its insulating properties. Such material is wholly unfit for electrical work. This "Mud Fibre" can be sold for from one-half (depending upon the available supply of clay) to one-quarter of the price of the genuine article.

BALL ENGINE COMPANY.

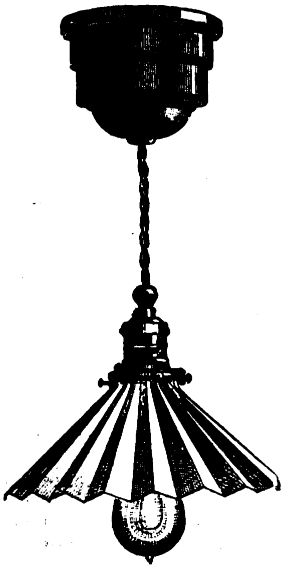
THE TAMPA STREET RAILWAY AND POWER COMPANY, Tampa, Fla., have ordered a 200 h. p. Ball Cross Compound engine from J. W. Parker, & Company, Philadelphia representatives of the Ball Engine Company, Erie, Pa.

DRY STEAM.

The Goubert Manufacturing Company, of 32 Cortlandt street, New York city, manufacturers of the well-known Stratton separator and of the Goubert water tube feed water heater, have issued a very attractive catalogue explaining the action of their apparatus. The pamphlet emphasizes the necessity of employing dry steam in order to obtain maximum economy, efficiency and safety and states the various methods of obtaining it. It is well illustrated with working drawings of the old and new styles of separators and heaters and contains an imposing list of vessels, companies and individuals using these devices, many of whom testify in the highest terms to their usefulness and efficiency.

THE ELECTRIC APPLIANCE COMPANY'S ADJUSTABLE ELECTROLIER.

The accompanying illustration represents something new in the line of an adjuster for raising or lowering incandescent lamps suspended on cords. It differs essentially from other devices for this purpose in the fact that the regulating device is attached permanently to the ceiling, taking the place of a ceiling rosette or cut-out. The cord is therefore not rendered clumsy by a heavy adjusting mechanism, and the movement up and down is more readily controlled and more certain. In appearance the adjustable electrolier is very neat, resembling a polished brass canopy. The Electric Appliance Company is looking after the interests of this new device in the west.



Electric Appliance Company's Adjustable Electrolier.

ENLIGHTENING THE PUBLIC.

The Champaign Electric Light and Power Company of Champaign, Ill., have gathered in a very neat little pamphlet, facts, data and information in regard to incandescent lighting. The book is intended for circulation among the people of Champaign, and sets forth clearly the advantages of adopting the modern light instead of clinging to gas. Some interesting comparative figures are quoted from The Electrical Engineer.

The pamphlet is well printed in two colors by the Champaign *Gazette*, and station managers in other cities may get many hints from it.

THE NEW STANLEY TRANSFORMERS.

We have received from the Ansonia Electric Co., of Chicago formerly the Electrical Supply Co., a handsome catalogue descriptive of the new Stanley transformers, for which they are the western agents. The catalogue describes the many novel features of these new transformers by which their efficiency is increased and in virtue of which they are practically proof against the destructive effects of lightning. The catalogue also brings out clearly the advantage of employing large single transformers instead of an equivalent bank of smaller ones.

The Casa Alameda Hotel, 63d street and Columbus ave., New York, will be furnished with power by two 80 h. p. Ball engines, built by the Ball Engine Company.

SYCAMORE WIRE.

The Sycamore Wire Factory of the Great Western Manufacturing Company is pushed to its utmost capacity in the manufacture of its well known weatherproof and magnet wires, and for the last two months has been running night and day. The high quality of its weatherproof wire commends it to all users, and in insulation quality and fineness of finish, it is claimed to be unsurpassed by anything in the market.

TELEPHONE MILEAGE IN THE UNITED STATES.

The following statement shows the mileage of wire in use in the United States for telephonic communication on January 1 of each year:

	Miles.		Miles.
1882	52,205	1888	202,617
1883	83,105	1889	243,764
1884	115,265	1890	279,941
1885	137,223	1891	331,642
1886	155,791	1892	381,554
1887	172.928	1893	421,027

THE HELIOS LAMP IN THE WEST.

The Ansonia Electric Company (formerly the Electrical Supply Company) have contracted for the western selling agency of the Helios arc lamp. It is a focussing lamp, and is claimed to be the only arc lamp that has been constructed to operate successfully on an alternating circuit. It was officially adopted by the German Government, and although its introduction into this country dates back scarcely ninety days, its reception has been marked with evident approval, as over five thousand have already been sold. With the celebrated Stanley transformers, and the Helios arc lamp, the Ansonia Electric Company certainly have a combination to win friends with every central station operating an alternating machine.

AN ELECTRIC SAFETY CURTAIN.

The first theatre in Europe known so far to use the electric iron curtain is the Comédie Française at Paris. The *rideau electrique* was put up and arranged by the Edison Electric Light Company. The curtain is hung by four steel wire ropes which run over pulleys and over a wooden drum driven from the pulley by an electric motor.

The counterweight is held by a cord to insure equilibrium at at any instant required. The speed at which the wheels run is about 1,800 revolutions per minute, and the motor which works the curtain is of two horse-power. The curtain can be let down at the maximum rate of 4¼ feet per second, the minimum being 2¼ feet per second, and the same speeds are available for lifting it. The current is supplied from the light circuit.

It is said that a similar device will be installed for operating the iron curtain at the Paris Opera House.

LUXURIOUS TRAVEL.

George H. Daniels, General Passenger Agent of the New York Central, has issued a handsome brochure of 32 pages entitled "Luxury of Modern Railway Travel." It is illustrated with 22 half-tones and several pen-and-ink sketches of scenes along the New York Central Road and of interiors and exteriors of various cars. It describes and illustrates the luxury of railroad travel as enjoyed on that road and its connecting lines.

ELECTRIC LIGHTING IN GLASGOW.

The great Scotch city of Glasgow has at last adopted electricity for its street lighting, and has on its own account installed a plant of 9 engines and 11 dynamos. The corporation will also go into the business of supplying incandescent lights to private consumers. The plant is Anglo-Brush. Dundee is also going in for similar municipal arc lighting.

The Chicago City Railway Company is pushing its construction of crosstown lines vigorously. These will all be operated electrically and will be completed in time for World's Fair traffic. There will be over 120 miles of crosstown electric roads. The Ansonia Electric Company (formerly the Electrical Supply Company), of Chicago, has secured the contract for the overhead equipment of these lines. The business of the Ansonia Electric Company is not confined to the sale of street railway supplies exclusively, but they have a distinctive railway supply department fully alive to all the requirements of their railway friends, and having several large factories in Ansonia, Conn., they can manufacture a superior line of supplies after their own models and fill orders expeditiously and satisfactorily.

WESTERN NOTES.

The Indiana Rubber and Insulated Wire Company announce the removal of their office from 242 Madison Street, Chicago, to Marion, Indiana, from which point they will hereafter transact all business and receive all communications, and where, with telephonic communication with their factory in Jonesboro, a few miles distant, they will be better able to do justice to their rapidly increasing business.

About a year ago this company opened its sales office in Chicago for the introduction of its Paranite insulations, then comparatively unknown to the trade. Being the only manufacturers of rubber-covered wires west of the Allegheny Mountains they found a convenient and ready market for their product, which is now sold extensively throughout all the middle and western states, and is in the hands of the best supply houses in all the large cities.

The Electric Appliance Company of Chicago, their general Western agents will continue to carry a large and complete stock of all sizes as heretofore.

The Patton Motor Manufacturing Co. have closed a contract to furnish additional motor cars of their particular system to the Louisville Terminal Railway Co. This has been granted after a six months' trial in which the Patton motor has given most excellent results. The officers of the company (Louisville Terminal) admit that the total operating expenses are less than seven cents per car mile. This is a very material saving when it is a fact that under any other system the expense is understood to average from 11 to 18 cents. It is authentically said that a 500 h. p. Patton motor will shortly be constructed to run between Chicago and New York drawing a Pullman car. This is being done to demonstrate the possibilities of this system on long-distance runs. The motor will make a speed of 60 miles per hour.

E. P. Roberts & Co., the new electrical engineering firm, of Cleveland, O., have been engaged by the village of Clyde, O., as consulting engineers. The village is about to install an electric light plant for city, street and commercial purposes, and has wisely called in expert talent to advise it. E. P. Roberts & Company are preparing specifications, etc., for the building as well as the steam and electric plants. Prof. Roberts, when in New York, last week, mentioned several other professional engagements secured by his company.

The Garton-Daniels Electric Company, of Keokuk, Ia., are enjoying a very brisk demand for their excellent lightning arresters. They are behind their orders and are running their factory to the utmost capacity. Orders are steadily flowing in for large equipments of entire railway systems. From the way the season opens, it looks as though the increase of business will compel them to increase greatly the size of their factory as well as their force.

The Electric Appliance Company have just issued catalogue Number Five, "Electric and Combination Fixtures and Fixture Accessories" and are making a specialty of this department of their business. The catalogue shows a very complete line of medium priced fixtures, and the Electric Appliance Company propose by having the line not over extensive to make up standard fixtures in quantities and reduce the cost materially to the trade.

The General Incandescent Arc Light Company, of New York, have opened a Chicago office and showroom at 175 Adams street, with Mr. L. E. Frorup in charge as Western representative. Assisting him is Mr. E. F. Webster, inspector for the company. The popularity into which the "G. I. A. L." lamp has jumped in the West has necessitated this move, so that all Western orders and inquiries can now be attended to very promptly.

The Jenney Electric Motor Co., of Indianapolis, Ind., have issued a very neat circular relative to the establishment of a branch office and warehouse in Chicago, where they will carry a large and complete stock of their generators and motors. They are getting out a World's Fair edition of their catalogue. The back of the circular has a cut of Electricity Building floor space, showing the location of the Jenney exhibit.

The contract for electric work in Ex-Governor Cooper's new ten story block in Denver, Col., has been awarded to the Russell & Officer Electric Construction Company of that city. They will install the Brush Electric Co.'s, apparatus, for which they are the agents, and some 250 Russell automatic switches.

The Ansonia Electric Co., formerly the Electrical Supply Co., have introduced a novel feature in the transformer business. In consideration of the payment of 5 per cent. additional to to the regular price of the Stanley moisture-proof transformers, the company now insures them for five years.

Mr. A. W. Meston, expert and superintendent of the Emerson Electric Manufacturing Company, of St. Louis, has gone on a trip through the West Indies for the benefit of his health, which it is hoped will be thoroughly restored on his return. He was to be gone about a month.

Seattle, Wash. W. T. Lacy and G. C. Phinney, the latter of whom is a local millionaire, propose to transmit the power of the Snoqualmie Falls electrically to Seattle. The straight line distance is only 15 miles, and it is proposed to make the initial plant 5,000 h. p. The falls have a total descent of 268 feet, and can easily develop hundreds of thousands of horse power. It is believed that a very profitable investment can be made.

Lundell Motors.—Attention is called to the fine exhibit of Lundell motors at the Central Electric Company's headquarters, Chicago, consisting of a complete plant of motor driving a generator, which in turn generates current to operate lamps, fan motors or the new Lundell exhaust outfit. High efficiency is shown in this combination and it is well worth one's time for examination.

McLeod's Car.—The new and palatial private car of President McLeod of the Philadelphia and Reading Railroad built by the Pullman Company, is equipped with Johnson switches, manufactured by the Interior Conduit and Insulation Company. The Central Electric Company, Western Agents, have a full supply on hand. The car was also wired throughout with Okonite wire.

Mr. F. De Ronde, general sales agent, representing the interests of the Standard Paint Co. of New York, has been busy the past ten days in Chicago completing arrangements for his company's exhibit at the World's Fair. An interesting exhibit is being planned, and as is usually the case with this popular company, some unique and pleasing fixtures may be looked for.

The Hill Clutch Works, of Cleveland, O., have issued a very neat and useful little pocket memorandum calendar and diary, which should be of service to everyone. It is supplemented by some pithy text about their clutches, pulleys, etc.

C. A. Daigh, Vice-President and General Manager of the National Electric Manufacturing Company of Eau Claire was a visitor in Chicago recently.

NEW YORK NOTES.

The Mica Insulator Company, 218 Water street, this city, have just issued a new sheet of information in regard to their admirable product, which is made of pure India sheet mica, and has already established itself as a standard insulator. It is now furnished in three grades of plate, and in segments for commutators, taper rings, tubes, armature troughs, armature rings, cloth, paint, etc. The illustrated catalogue furnishes some interesting and valuable data and should be sent for.

The Utica Electrical Manufacturing and Supply Company, of Utica, N. Y., describe in their recently published catalogue various forms of their switches, lightning arresters, etc. Most of these instruments have been illustrated in our columns, and, taken together, make a fine array of highly interesting apparatus. The last ten pages are occupied by tables relating to wiring and units of measurement, which will be found very useful both to engineers and electricians.

Carpenter Rheostats. It is understood that the Carpenter Enamel Rheostat Company has made a very advantageous contract with the General Electric Company under which the latter will use the rheostats and other specialties of that nature, in its work.

NEW ENGLAND NOTES.

Mr. J. Bradford Sargent, of the Stirling boiler, New England Agency, reports the following sales of Stirling water tube boilers have been made within the last ten days: Union Railway Co., New York City, 1,500 h. p.; Lindell Avenue Street Railway Co., St. Louis, 2,700 h. p.; General Electric Co., Cleveland, Ohio, 400 h. p.; Crown Brewery, Philadelphia, 400 h. p.; Hide Park Electric Co., Chicago, (third order) 700 h. p.; Siemens & Halske Co., Chicago, 500 h. p., besides many smaller sales. The Sterling boiler is meeting with remarkable success. The Company is crowded with orders, and is running its works night and day. Catalogues, testimonials and full information concerning these boilers can be obtained from J. Bradford Sargent, 620 Atlantic Avenue, Boston, Mass., who has the New England agency.

Hartford, Conn. A new electric railway conduit system, with electro-magnetic sectional devices, has recently been put in experimental operation at Hartford by Mr. J. F Munsie, its inventor. It is claimed that the short section tested has yielded good results.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

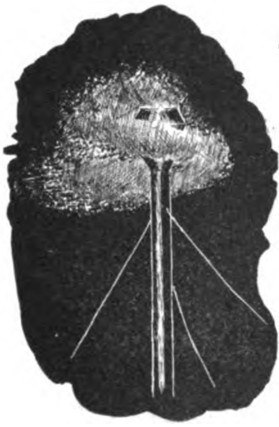
Vol. XV. APRIL 5, 1893. No. 257.

THE SPRINGFIELD, ILL., ELECTRIC LIGHT AND STEAM DISTRIBUTION PLANT.

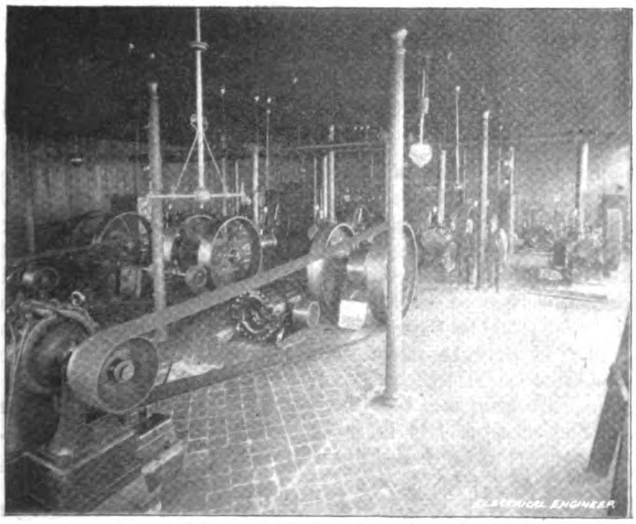
BY

Leslie W. Collins

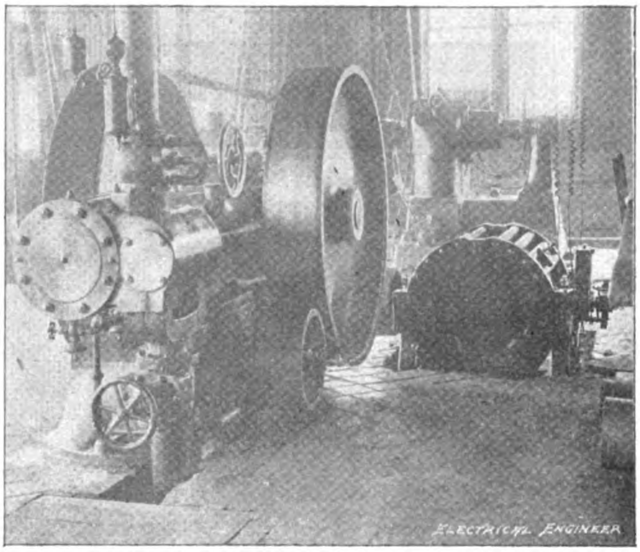
I.



IT WILL no doubt be remembered that in the June 1, 1892, issue of The Electrical Engineer, Mr. W. Forman Collins gave a short description of the utilization of exhaust steam for heating by the Springfield, Ill., Electric Light and Power Company's plant, and then called attention to the high economic efficiency of the station from a financial point of view. The steam having done its work in furnishing light and power, was then sold for heating purposes, the margin of profit in this same exhaust steam being a very pleasing contemplation for the stockholders. Since that time, such is the satisfaction this plant has given, they have recently very largely increased it. The subject is one of such great importance that it deserves the fullest description and consideration. I have therefore availed myself of the opportunity afforded by a recent visit to Springfield to obtain all the data that I could secure; and I have embodied the information in the present article for the benefit of any other central station officers who are interested in the question. It seems to me that for a great many plants this utilization of exhaust steam must prove a most welcome addition to the income and profit; but I will leave them to judge for themselves.



Dynamo Room, Springfield Electric Light and Power Co.



Thomson-Houston Arc Machine, with "Ideal Transmitter," Springfield, Ill.

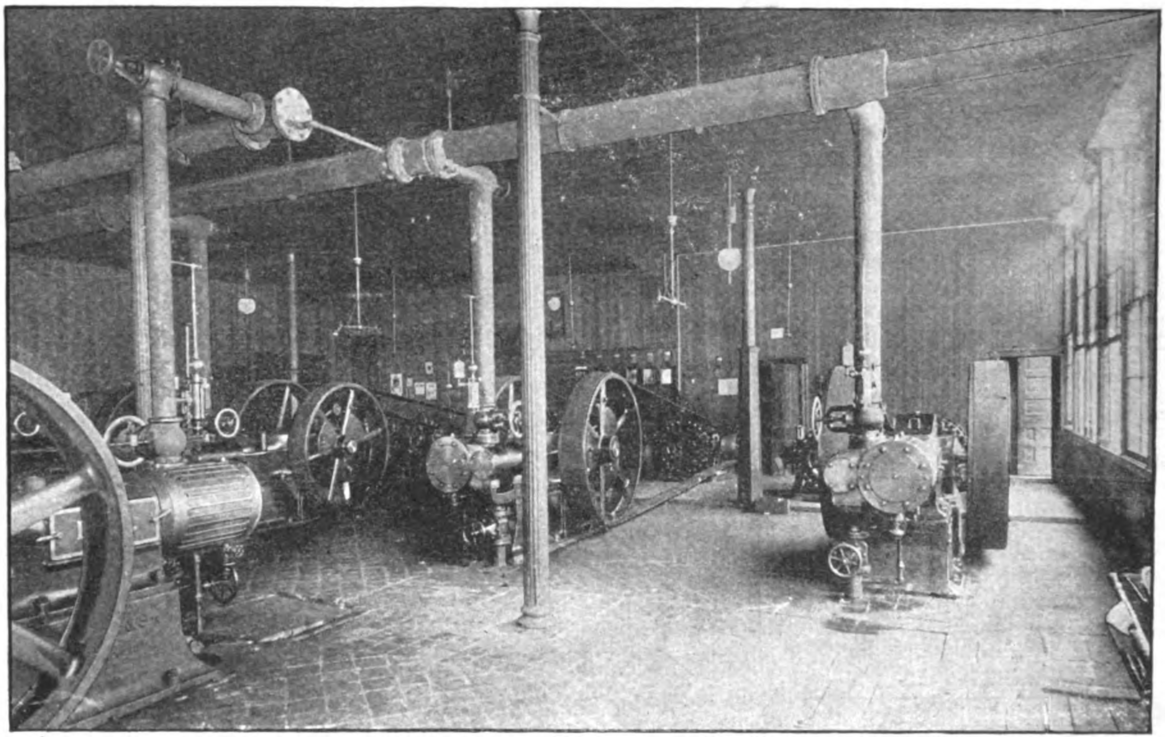
II.

Springfield, Ill., was one of the first cities to adopt electric lighting to any extent. Away back in 1879, Springfield had a "station." It was a plant located in the then very modest shops of the A. L. Ide Engine Company. Mr. Ide is a most persistent student and experimenter, and it was natural that he should establish the plant in his own shops. A company was formed and commercial lighting was started. The building was formerly used as a church, but more suitable quarters being required by the church people the old house of worship was sold. It was in the heart of the city and made a most excellent site for the fast increasing business of the company. This building received the necessary repairs and rearranging and made a very good station building for a number of years, but the business grow until it became neccessary to enlarge the plant. A plan was soon arrived at, and it is unnecessary to name the man first to decide what was best to do. Work was begun at once. Foundations were laid outside the old church building, and to day there stands a magnificent large brick two-story light and power station. There are few better plants in the United States.

III.

The plant of to day consist of five 50-light and one 35-light arc machines; two 1,300-light Thomson-Houston alternators; one 75 h. p. stationary motor generator and three 80 h. p. railway generators.. The company furnishes current for the different electric railways in the city. There is also a nice little business done in supplying current for stationary motors. The engine plant comprises five 125 h. p. Ideal and two 150 h. p. Ideal engines. The boiler plant comprises 780 h. p. of Ide boilers. My object is to say a little more regarding the excellent satisfaction given by the Holly system of steam heating also furnished the citizens of Springfield by the Electric Company. The system has been in use now in Springfield about three years and has given excellent results to both company and consumer. The original plant, laid in the winter of 1890, consisted of about a quarter of a mile of pipe, and each year since has seen a doubling of the system. Some consumers whom I called on were enthusiastic over the service. I interrogated them pretty thoroughly.

There are about 60 consumers now on the company's books within a radius of about eight blocks. About ten thousand feet of street mains are now laid, and including the last six months' additions to the plant, the company are serving about 3,000,000 feet of space or in other words about 40,000 feet of direct radiation. The company guarantees to deliver two lbs. pressure at the consumers main valve, and a recent test made at a distance of five blocks from the station showed less than ¼ lb. loss. As before mentioned, the system in use is that manufactured by the American District Steam Company of Lockport, N. Y. The street mains as installed in the Springfield plant are a wrought iron pipe wrapped with a special asbestos or mineral wool covering manufactured by the H. W. Johns Company. This is again covered with a tin lined wooden shell. Variators are placed every 50 feet thus making allowance for expansion and contraction. The principle of the variators is similar to that of an expansion joint, and prevents any possibility of steam escaping. These variators also have spurs or joints for making building connections. During the first and second years of its adoption the company had about 1,000,000 cubic feet of space in connection, thus making an extension of about 2,000,000 cubic feet during the past year. No better evidence than these statistics could be required of the favor with which exhaust steam-heating has been received in Springfield by those who have been fortunate enough to have their buildings connected. A most excellent test of the system has been rendered possible this winter on account of its severity. No complaint whatever was made. It seems almost incredible, but during the most severe weather and with but three 125 h. p. engines running, the company have been able to furnish ample heat—except on two of the most severe nights—without the aid of a pound of live steam, the exhaust of the three Ideal engines doing the work perfectly. To give a more adequate idea of the perfection of the system, I may mention the fact that even where the first mains were laid three years ago, the ground has not since been broken for repairs.



Dynamo Room showing Exhaust Steam Distribution Pipes, Springfield, Ill.

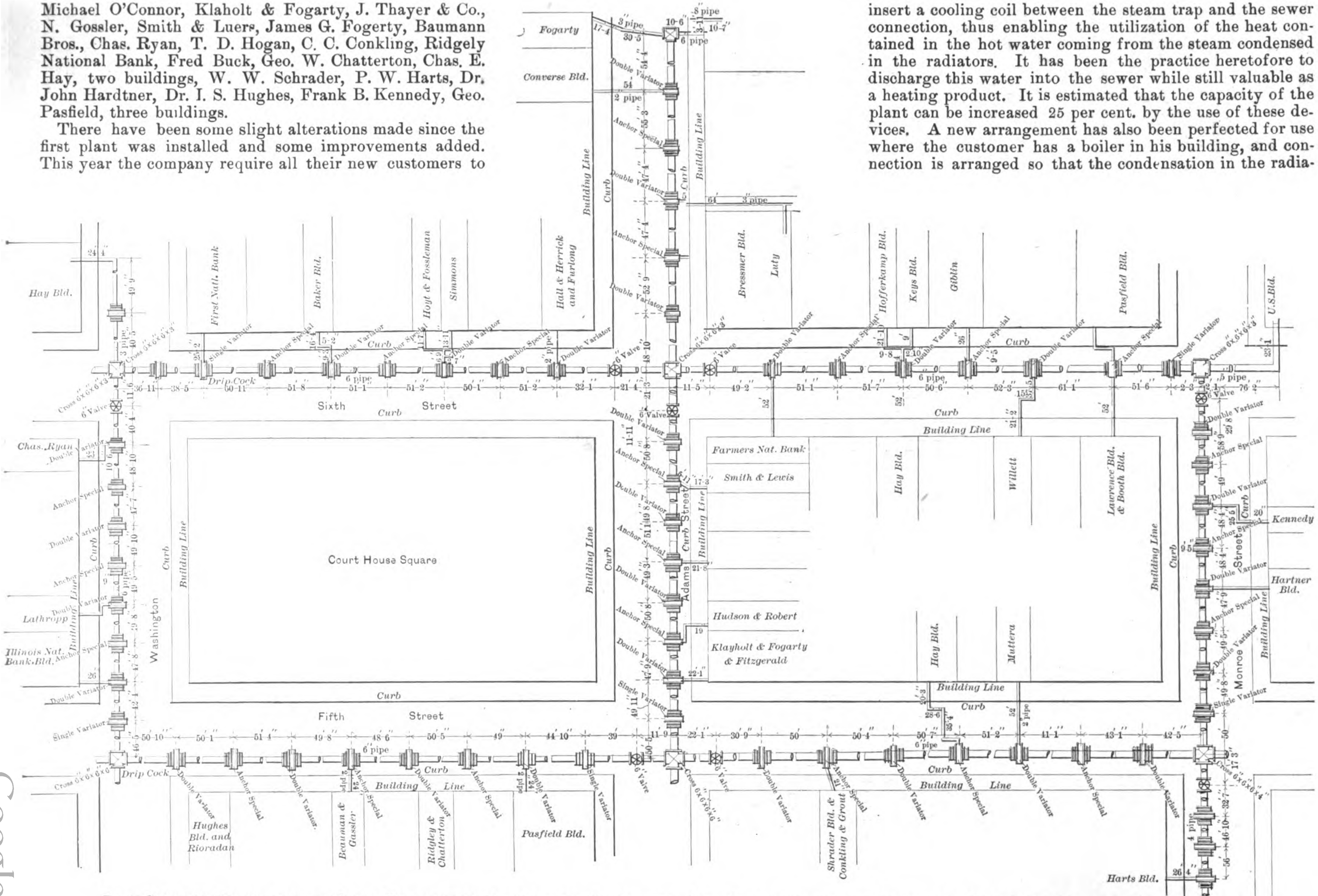
IV.

The accompanying diagram shows a plan of the streets upon which the mains for steam-heating purposes are laid. Referring to the plan view of the mains, starting out from the station which is located on Seventh and Adams streets, they run to Sixth street with eight-inch piping, then branch south to Monroe and north to Washington street with a six-inch piping, on west to Fifth street with eight-inch piping, branching north and south to Monroe and Washington street with a six-inch piping and are joined at each end of the mains on Monroe and on Washington from Fifth to Sixth street also with a six-inch main. There is now laid about 300 feet of eight-inch main, 3,000 feet of six-inch main and 150 feet of four-inch main. The latter is what is called a private main on Monroe street leading to the Post Office building.

The following is a list of customers supplied with steam from the station. It is interesting in that it includes all the most prominent merchants, bankers, etc., of Springfield :

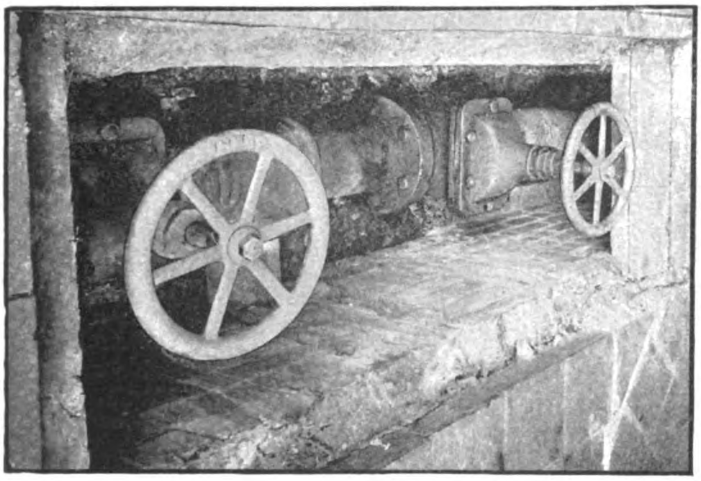
John Bressmer, Farmers National Bank, First National Bank, George Pasfield, R. D. Lawrence, Frank Simmons, S. J. Willett, George Hofferkamp, Booth & McCosker, James Furlong, Patrick Giblin, Hall & Herrick, Frank & Kuhl, Wilton Hay, Elwood D. Keys, James M. Brittain, W. B. Baker, Hoyt & Fosselman, W. O. Converse, United States Court House and Post Office, Nora M. Fitzgerald, Michael O'Connor, Klaholt & Fogarty, J. Thayer & Co., N. Gossler, Smith & Luers, James G. Fogerty, Baumann Bros., Chas. Ryan, T. D. Hogan, C. C. Conkling, Ridgely National Bank, Fred Buck, Geo. W. Chatterton, Chas. E. Hay, two buildings, W. W. Schrader, P. W. Harts, Dr. John Hardtner, Dr. I. S. Hughes, Frank B. Kennedy, Geo. Pasfield, three buildings.

There have been some slight alterations made since the first plant was installed and some improvements added. This year the company require all their new customers to insert a cooling coil between the steam trap and the sewer connection, thus enabling the utilization of the heat contained in the hot water coming from the steam condensed in the radiators. It has been the practice heretofore to discharge this water into the sewer while still valuable as a heating product. It is estimated that the capacity of the plant can be increased 25 per cent. by the use of these devices. A new arrangement has also been perfected for use where the customer has a boiler in his building, and connection is arranged so that the condensation in the radia-

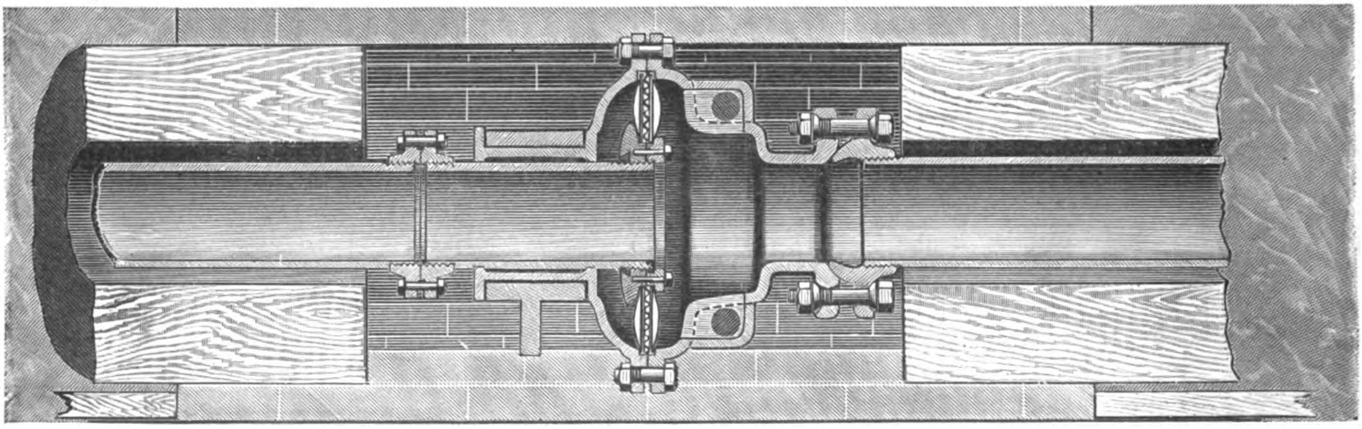


Plan Showing Connections to Steam Distribution Plant of the Springfield, Ill., Electric Light and Power Co., Holly System.

tors passes while still hot, into the boiler which was formerly used for the private plant, and is trapped from the boiler to the sewer automatically. Then in case of a fire or other disturbance causing a shut down at the station, the consumer's old plant is ready at five minutes notice to furnish its own steam, as the boiler being partially filled with hot water, it therefore takes but a short time to get up steam. This is a very simple and excellent device, although it is not very likely to be called into requirement; but if anything should arise to necessitate its use it will be exceedingly handy.



Connection of Exhaust with Street Steam Mains.



"Variator" or Expansion Joint, Holly System of Steam Distribution.

V.

I have given the story of the plant from my own observation and notes, but I may now supplement it with a very interesting letter written last February by Mr. Ide, as president of the Springfield Company, to a local electric light company inquiring about the operation of the system. It is as follows:

In reply to your letter of Feb. 15, our steam heating has proven entirely satisfactory to all consumers and ourselves. We are heating over 50 buildings, and the only complaint is that they had too much heat in the buildings where we removed boilers; even in the coldest weather they had to shut off some of the radiators and a number of those places have taken out a portion of their radiation. We took on about 25 additional stores, including the Government Post Office, last fall, and under our advice, from past experience, they put in one foot of surface for every 80 feet of air space except in the very exposed corner rooms, where they put in one in 70. This has proven entirely sufficient and as you will see, it is a third less surface than would be required in heating with low-pressure boilers in the building.

We have two corner drug stores that are warmed by 1 in 80 direct radiation and they find their rooms abundantly warm when it is 10 degrees below zero. We have just been awarded the contract for warming the County Court House for five years although they have a complete plant of their own. They have made contract with us for warming the building at about the price they pay their engineer and only a little more than they have been paying for their fuel.

We are now receiving about $8,000 per year and have made a rate of 20 cents per year per square foot of surface for direct radiation, and 25 cents for indirect. But owing to the small quantity of radiating surface required, we have concluded we made the rate too low and intend to raise it to 25 cents per square foot as this appears to be cheap enough. Under this rate, they can heat stores, first floor, for $50 per year that they have been paying us $80 to $100 by the lump contract rate which we originally made.

We are furnishing about 200 h. p. to the Electric Street Railway and as we have taken on customers which require about 300 h. p. in cold weather, we have to supply about 100 h. p. in live steam during the day time only. As soon as we start up our lights at night, then we heat entirely by exhaust steam. We are warming about 3,000,000 feet of space. We can judge pretty well by the size of our fuel bill. Since last year we have taken in $3,000 additional in receipts for heating, and during the same months it has increased our fuel bill only about $100. The entire system is working perfectly, has not given us the slightest trouble in any respect, and does not require any attention or any extra help.

If your station is not located too far away from the principal consumers, you can certainly make it profitable to put in the American District Steam Company's system. We investigated the matter very carefully and concluded they had the only perfect and satisfactory system, and experience has demonstrated that it is all they claim for it.

We would be pleased to have you make a visit to Springfield and see the plant in operation and talk with the users. This would be the most convincing and satisfactory proof for you as regards the successful and profitable operation of the system. Our net receipts from our steam system will pay the entire cost in three years.

VI.

It has occurred to me that I might also wisely supplement my article by incorporating with it the forms of contract used by the Springfield Electric Light and Power Company in its steam supply work. They are therefore given below:

Preliminary Agreement for Steam Heating Service.

Springfield, Ill.,............ ....189..

Pending the Completion of the installing of steam pipes and radiators in the property of..
situated at...
and the ascertaining of the exact number of square feet of radiation to be connected, it is hereby agreed by and between the

Springfield Electric Light and Power Co.,

(*The Company.*)

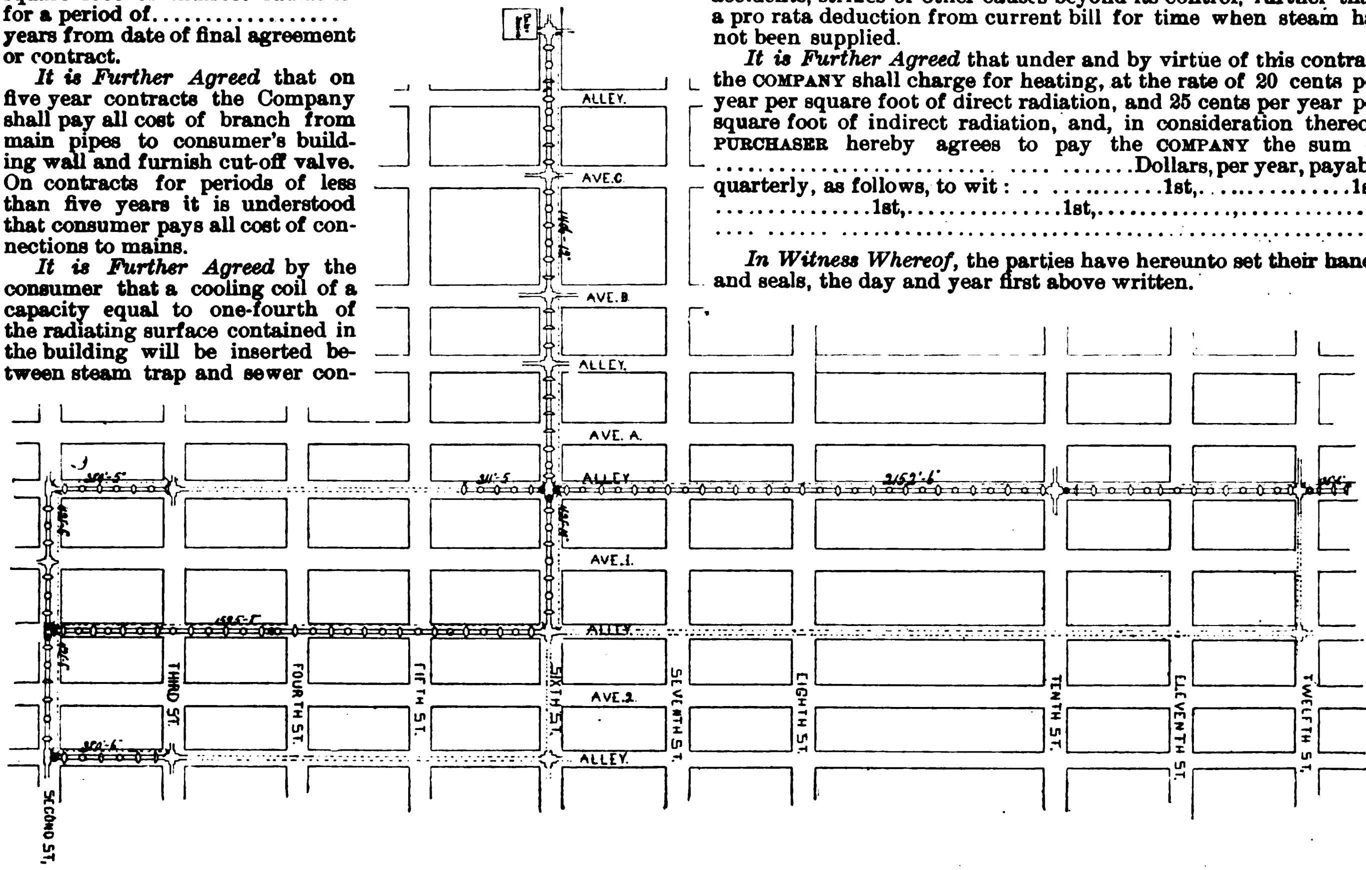
and...

(*The Consumer.*)

that all steam required for heating shall be furnished by the Company and paid for by the consumer at the rate of 20 cents per year per square foot of direct radiation, and 25 cents per year per square foot of indirect radiation for a period of.................. years from date of final agreement or contract.

It is Further Agreed that on five year contracts the Company shall pay all cost of branch from main pipes to consumer's building wall and furnish cut-off valve. On contracts for periods of less than five years it is understood that consumer pays all cost of connections to mains.

It is Further Agreed by the consumer that a cooling coil of a capacity equal to one-fourth of the radiating surface contained in the building will be inserted between steam trap and sewer connection, this coil to be used as an indirect radiator, the Company agreeing to charge for same, as direct radiation.



Plan showing System of Steam Distribution Installed by the American District Steam Co., at Cedar Rapids, Ia.

In Witness Whereof, the parties have hereunto set their hands and seals, the day and year first above written.

Springfield Electric Light and Power Co.,
[Seal.]

By......................................

....
Consumer.

Springfield Electric Light and Power Co.

Steam Supply Contract.

This Agreement made this.............................day of ....189..., by and between the Springfield Electric Light and Power Co. (hereinafter called the company) and.. (hereinafter called the purchaser), Witnesseth: That the company agrees to furnish from its Electric Light Station, in Springfield, sufficient steam for properly filling the radiators in the purchaser's building, situated.. in said City of Springfield, for the term of..................years commencing................189..., and ending................ 189..., said radiators containing......................square feet of direct radiation and...................square feet of indirect radiation; the company further agreeing to maintain a pressure of two pounds at the main service pipe valve at all hours when required, both day and night.

It is Further Agreed that purchaser shall pay all cost of making connection to company's street mains, and shall also provide a gate valve for shutting off steam, at point where steam pipe enters building, this valve to be under the control of the company.

It is Further Agreed, that the company or any of its agents shall have access to the premises at all reasonable and proper hours to inspect the apparatus, and that the purchaser will not consume, use or waste more steam than is necessary to properly warm the following space within the aforementioned property:—
.... and will have steam shut off from radiators in rooms not in daily use and when heat is not required.

It is Further Agreed, that the company shall not be held liable for failure to furnish steam, if such failure is caused by accidents, strikes or other causes beyond its control, further than a pro rata deduction from current bill for time when steam has not been supplied.

It is Further Agreed that under and by virtue of this contract the company shall charge for heating, at the rate of 20 cents per year per square foot of direct radiation, and 25 cents per year per square foot of indirect radiation, and, in consideration thereof, purchaser hereby agrees to pay the company the sum of ....Dollars, per year, payable quarterly, as follows, to wit: ....1st,..................1st, ...1st,................1st,................................

In Witness Whereof, the parties have hereunto set their hands and seals, the day and year first above written.

Springfield Electric Light and Power Co.,
[Seal.]

By..
[Seal.]

These documents embody the terms upon which the supply is now given, and are found quite satisfactory by the consumers. Springfield, the capital of the State, is not an exceptional city, and I believe that what has succeeded so well there, will be equally beneficial and profitable in any other equally progressive and appreciative community. I have also included a plan of the service that has recently been installed in the same manner as above described, at Cedar Rapids, Ia. It will be seen that the system there constitutes an extensive addition to the lighting plant and to the operations of the local company.

THE LODYGUINE PROCESS OF PREPARING FILAMENTS.

In a recently described process of treating incandescent lamp filaments devised by Mr. A. de Lodyguine, of Paris, the material is first carbonized and placed in a chamber from which the air is afterward exhausted. A current of electricity is then sent through the filament while *in vacuo*, of such strength as to drive off the occluded gases contained therein. After the filament has been thoroughly freed from the occluded gases, a current is passed through it of sufficient strength to change its character from the original carbonized filament, into the form of coke. This step is carried on *in vacuo*, in about eight seconds. The strength of current used is as great as the filament will practically bear without breaking. In some instances the two steps are combined. By thus coking the filament, its permanent or cold resistance is caused to change, being gradually reduced until it has become approximately the same as the hot resistance of the filament before it was coked. When the resistance has reached its lowest point, it tends to again rise, if this step of the treatment is continued. The filament, after it has been thus electrically coked, is placed in the bulb and the lamp finished and made ready for use in the usual way; or the coked filament may be further treated by the deposition of carbon upon its surface. This is accomplished by placing it in a closed vessel charged with a hydrocarbon or other carbonaceous gas, and passing a current of electricity through it sufficient to heat it to such a temperature that the gas will be decomposed and carbon deposited upon the coked core.

Mr. de Lodyguine finds that silk gives the best results when treated by his process, an account of its uniformity of texture.

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY.—XVI.

BY

A. E. Kennelly

Stress Distributions. (Continued.)

We may next consider the stress exerted upon magnetizable particles situated in a magnetic field. This case is practically represented in the moving force of iron filings toward magnets. For the sake of simplicity we may first suppose that the attracted particles are all of spherical form.

When an iron sphere of radius r, and permeability μ is placed in a uniform prime flux of density B_p, we may imagine that every elementary rod, or line of particles in the sphere, parallel to B_p, becomes magnetized, and establishes its own local magnetic circuit. Part of the induced flux in completing each rod's circuit, permeates the substance of all the other rods, more or less obliquely, but in a direction opposed to the prime intensity B_p. Every rod is thus acted upon by B_p in one direction, and by the return or counterflux from the rest of the sphere in the opposite way, and the induced M. M. F. in the iron is locally μ-1 times the resultant B_r of these opposing fluxes. The ellipsoid is one of the few geometrical forms for which the resultant has been determined, and under this classification the sphere makes its appearance as a particular case. It can be shown that within the substance of a magnetizable sphere the counterflux is uniform and just one-third of the induced intensity B_i, so that the resultant prime intensity B_r throughout the sphere is

$$B_r = B_p - \frac{B_i}{3}; \text{ and since } B_i = (\mu - 1)\ B_r,$$

we must have

$$B_r = \frac{3\ B_p}{\mu + 2} \text{ and}$$

$$B_i = (\mu - 1)\frac{3\ B_p}{\mu + 2}.$$

The total intensity within the sphere B_s being the sum of the resultant and induced intensities, represented by these last two equations, will be

$$B_s = \frac{3\ \mu\ B_p}{\mu + 2}.$$

Thus with a sphere of Norway iron, these component internal intensities would assume values dependent upon the prime flux density in a manner outlined by the following table. The values of μ are supposed to have been determined either directly, or by correspondence with known samples of iron.

Prime intensity B_p.	Resultant of prime and counterflux intensities B_r.	μ.	Intensity induced in sphere by its M. M. F. B_i.	Total intensity in sphere $(B_r + B_i)$. B_s.
1	$\frac{3}{152} = 0.0197$	150	$\frac{1 x 3 x 149}{152} = 2.941$	$\frac{1 x 3 x 150}{152} = 2.9607$
2	$\frac{3 x 2}{164} = 0.0370$	160	$\frac{2 x 3 x 159}{162} = 5.890$	$\frac{2 x 3 x 160}{162} = 5.927$
10	$\frac{3 x 10}{222} = 0.1351$	220	$\frac{10 x 3 x 219}{222} = 29.60$	$\frac{10 x 3 x 220}{222} = 29.7351$
100	$\frac{3 x 100}{602} = 0.498$	600	$\frac{100 x 3 x 599}{602} = 298.5$	$\frac{100 x 3 x 600}{602} = 298.998$
1,000	$\frac{3 x 1{,}000}{3{,}002} = 0.999$	3,000	$\frac{1{,}000 x 3 x 2{,}999}{3{,}002} = 2{,}997.$	$\frac{1{,}000 x 3 x 3{,}000}{3{,}002} = 2{,}998.$
5,000	$\frac{3 x 5{,}000}{502} = 29.88$	500	$\frac{5{,}000 x 3 x 499}{502} = 14{,}910.$	$\frac{5{,}000 x 3 x 500}{502} = 14{,}940.$

It is evident that the counterflux nearly neutralizes the prime intensity within the sphere for all ordinary conditions, while the induced, and also the total intensity are almost three times the prime. Immediately outside the sphere, the distribution of flux is of course no longer uniform, since the prime flux is here compounded with the return flux from the sphere which completes its local circuit by curving paths, but the equipotential curves for this local circuit correspond in outlines to those represented in Fig. 5, Chap. III. The table and formulæ also show that the value of μ may vary through wide limits without much alteration in the total intensity, so that if we take spheres of iron, nickel, cobalt, or even ferroso-ferric oxide, and place them in a uniform magnetic field, the intensity within their substance will be uniform, and usually not far from three times the prime.

Having then determined the values of the uniform prime intensity, and the corresponding intensity within the sphere from the assumed range of μ, we have next to ascertain the stress which this distribution will exert upon the sphere as a rigid body. For this purpose we may replace the iron sphere by its equivalent active coil, and determine the stresses set up on that coil by the foregoing rules. The coil must be of negligible thickness, and be wound upon a sphere of wood or other non-magnetizable material, having the same dimensions as the iron sphere it replaces. Within the wooden sphere we have to produce a uniform total intensity of $\frac{3\ B_p\ \mu}{\mu + 2}$, and since B_p is the prime intensity existing within the coil before it is excited, the uniform flux density that the coil must create within it, and superpose, is

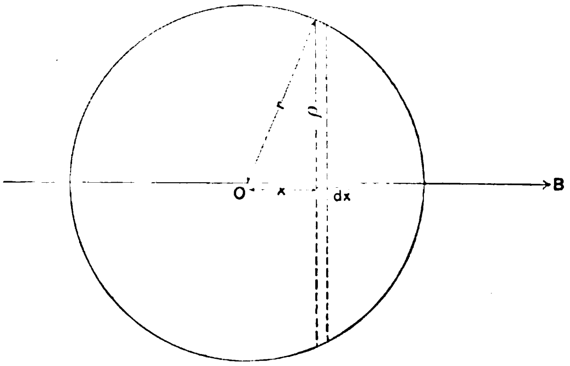


FIG. 35.

$$\frac{3\ B_p\ \mu}{\mu + 2} - B_p = 2 B_p \left(\frac{\mu - 1}{\mu + 2}\right),$$

and this practically becomes $2 B_p$ when μ has a large value.

We have already seen in Chap. III, that a winding of C

current turns per axial centimetre disposed on the surface of a non-magnetizable sphere, produces everywhere within it the uniform flux density of $\frac{8 \pi C}{3}$, and consequently the current turns on this wooden sphere must be

$$C = \frac{3}{8 \pi} \times 2 B_p \left(\frac{\mu - 1}{\mu + 2} \right) = \frac{3 B_p}{4 \pi} \left(\frac{\mu - 1}{\mu + 2} \right)$$

per centimetre slice perpendicular to B_p. All that now remains is to find the magnetic stress on the coil with this excitation.

Taking any thin slice in the winding and considering it separately (Fig. 35), we have an active ring at right angles to a uniform prime flux B_p. There will be a stress radially outwards all round the ring, which its rigidity will hold in check, but there will be no tendency to motion along the line of B_p in either direction, and consequently the entire coil, or the iron sphere, its equivalent, will be in equilibrium so far as regards resultant magnetic stresses. It follows, therefore, that a homogeneous sphere of iron or magnetic material will remain at rest in a uniform magnetic field of any intensity, just in the same way that a compass needle freely suspended in the earth's flux (assumed to be uniform) exhibits directive tendencies, but no inclination to move bodily towards either geographical pole.

Suppose, however, that the prime intensity B_p in which the iron sphere rests, is no longer uniform, but increases steadily by b C. G. S. lines for every centimetre of distance along the line of B_p, while the radius r of the sphere is so small relatively to b that the variation of the intensity existing within its interior may be neglected. Then if the equivalent active coil were a single plane loop perpendicular to B_p of radius ρ carrying a current C, we know that the resultant stress on this loop would be $b \pi \rho^2 C$ dynes along the line of B_p, for the total increase in the flux enclosed by the loop, per centimetre of its excursion along B_p would be b times the area, and the resultant stress is this rate of flux absorption multiplied by the current in the loop.

Since the coil in this case is a spherical shell we have to divide it into elementary loops and sum their respective resultant stresses. In Fig. 35, at any distance x from the centre of the sphere measured along the line OB, the radius of any elementary slice of thickness dx is

$$\rho = \sqrt{r^2 - x^2}$$

and the equivalent current round this slice is

$$C\,dx = \frac{3 B_p}{4 \pi} \left(\frac{\mu - 1}{\mu + 2} \right) dx.$$

The elementary pull on the slice is then $dP = b C \pi \rho^2 dx = b C \pi (r^2 - x^2) dx$ and the total pull on the sphere will be the integral of this expression between the limits $x = \pm r$,

$$\text{or } P = b C \frac{4 \pi r^3}{3} = \frac{3 b B_p}{4 \pi} \left(\frac{\mu - 1}{\mu + 2} \right) \frac{4 \pi}{3} r^3$$

$$\therefore P = b B_p r^3 \left(\frac{\mu - 1}{\mu + 2} \right).$$

Also if the variation of prime intensity be no longer simply b per cm., its local rate of increase or gradient will be expressed in all cases by

$$\frac{d B_p}{dx}, \text{ and } P = r^3 B_p \frac{d B_p}{dx} \left(\frac{\mu - 1}{\mu + 2} \right)$$

which, since μ is generally large, becomes practically

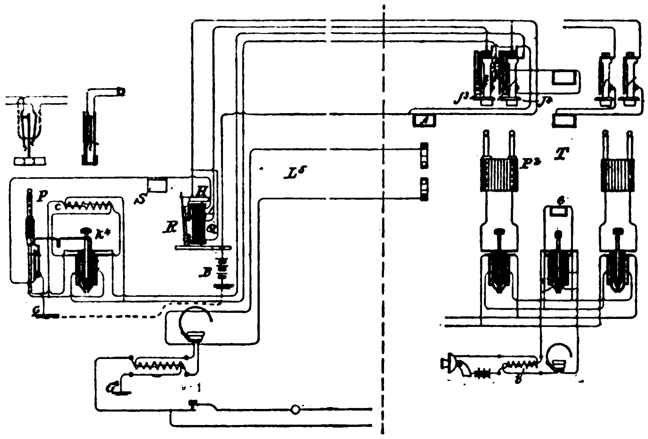
$$P = r^3 B_p \frac{d B_p}{dx} \text{ dynes.}$$

These last two equations embody all the principal facts concerning the apparent attraction between magnets and spherical magnetizable particles. This attraction is nearly the same in the same magnetic flux, and for spheres of the same diameter, whether the substance of the sphere be iron, steel, nickel, cobalt, or Fe_3O_4, since in all these substances, the factor $\left(\frac{\mu - 1}{\mu + 2} \right)$ will not usually be far below unity.

THE "LONG DISTANCE" TRANSFER SIGNALING SYSTEM.

In the operation of telephone exchanges it has heretofore been requisite to transmit an order over the instruction circuit, not only for connections between toll and local circuits, but also for disconnections, which thus involves two communications over the instruction circuit for each connection. In order to reduce the work required of the operators and to save time, the "Long Distance" Telephone Company have recently introduced a method which makes it necessary to use the instruction circuit between the operators only once, namely, in ordering the establishment of a connection; the disconnection at the toll board being indicated automatically at the local board. The system, due to Messrs. F. A. Pickernell and F. W. Dunbar, of the engineering staff of the Long Distance Company is shown diagrammatically in the accompanying engraving.

The operator at the local board represented at plug P lifts it from its grounding socket and thereby throws a ground G on the system, allowing the battery B to work through the annunciator drop A and the two low resistance coils a^2 and S, S being the automatic disconnecting signal which can only be thrown when both the high resistance coil Q and annunciator drop A are short-circuited. The drop A being thrown, the connection is in the hands of the Long Distance operator represented at T. By inserting her plug P^2 into its corresponding spring jack the high resistance coil on the relay R is thrown into circuit, it being normally short-circuited by the closed contact on the spring jack J^2. The relay thus responds and closes the contact at q^2, which short-circuits the annunciator A and allows it to be restored by the operator; or if it be an automatic restoring visual signal it is automatically restored.



THE "LONG DISTANCE" TRANSFER SIGNALLING SYSTEM.

The operator T on receiving a disconnecting signal from the subscriber by means of the drop e provided for that purpose, withdraws the plug P^2 from its spring jack, which again short-circuits the high-resistance winding on relay R. The battery now works only through the two low resistance coils on the relay R and the automatic disconnecting signal S. The signal is thrown and the relay armature retained in its thrown position. The operator at P on answering the disconnecting signal and restoring her plug into its grounding socket throws all apparatus back into its normal position.

If a connection originates at the Long Distance toll boards, the working of the apparatus is similar in all respects after inserting the plug P^2 into its spring jack, the order being given by a special order circuit as shown at L^5, to the operator at P.

In the diagram an extra contact is shown on spring jack, J^4, which is only used to prevent the drop A (if the ordinary annunciator drop is used) from being thrown on inserting the plug P into spring jacks J^3 and J^4. If the automatic annunciator similar to S is used, this contact becomes unnecessary. The apparatus shown at k^4 is simply a device for inserting a repeating coil into the line if a grounded circuit is to be connected with the Long Distance line. On pushing the button k^4, the repeating coil is inserted and is automatically disconnected from the circuit by re-inserting the plug P into its grounding socket at the conclusion of the connection.

NON-SYNCHRONOUS SINGLE PHASE ALTERNATING MOTORS.

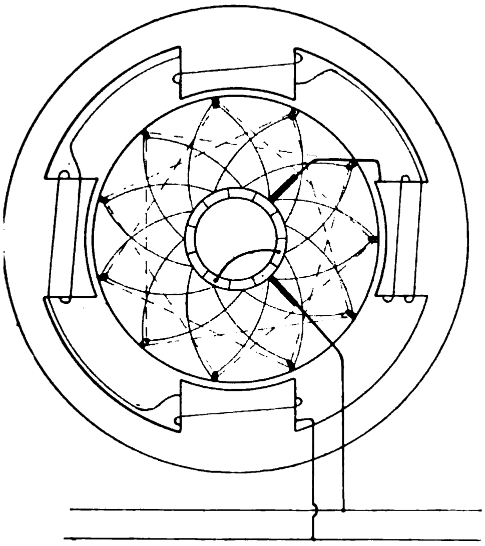
BY

Herbert A. Wagner

The recent articles by Mr. C. E. L. Brown and Mr. E. Arnold, published in The Electrical Engineer, recall some experiments made by the writer about six months ago. A motor had been made for use in starting a larger synchronous motor, and consisted of a drum armature with a progressive winding in grooves ; an ordinary commutator, and multipolar field, the armature and field coils being connected in series.

Before being put to the use for which it was intended, this motor was experimented with in numerous ways. In one of these it was run as an induction motor, and the armature winding was short-circuited by a wire connecting opposite points of the commutator, as shown in the accompanying sketch, the brushes being retained in the field circuit, to provide a means for starting. With the windings short-circuited in this way, the motor ran well non-synchronously, nearly approaching a synchronous speed when running idle, and falling off slightly in speed as load was applied.

In starting it was found unnecessary to remove the short-circuiting device, as on turning on the current and giving the armature half a turn by hand, it started off with a very vigorous torque, bringing its full load up to speed. There was, of course, no sparking at the brushes, either in starting or in running.

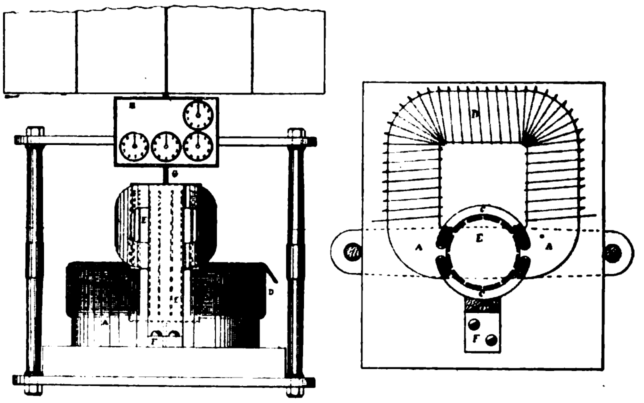


Wagner Single Phase Alternating Motor.

This motor was tried only on a current of 130 periods and was found, with the winding described, to require a large magnetizing current. The experiment served to suggest other devices and modifications of windings, with some of which very good results have been obtained, even at the high frequency mentioned. As the field for single phase motors in this country at the present time is limited almost entirely to frequencies of over 100 periods per second, the problem here becomes much more difficult than the one apparently so near solution abroad.

THE STANLEY ALTERNATING CURRENT METER.

A new form of alternating current meter has recently been devised by Mr. William Stanley, Jr., of Pittsfield, Mass., the construction of which is shown in the accompanying diagrams, Figs. 1 and 2.



Figs. 1 and 2.—Stanley Alternating Current Meter.

Between the poles of the laminated core A there is a copper cylinder E in which a number of longitudinal slots are formed. This cylinder projects out one side beyond the polar faces of the core A and is supported on pivotal bearings so as to turn freely. The projecting portion of the cylinder E is inclosed by circular coils C, C, placed on opposite sides so that their magnetic axes pass through the cylinder at right angles to that of the coils D and core A. The spindle G upon which the copper cylinder is mounted is in gear with a registering train and dials H, and is loaded in the usual manner by a fan.

The coils D and C constitute two independent field-producing circuits the currents in which differ by approximately a quarter phase or ninety degrees, so that at that instant of time when one field exhibits its maximum magnetic effect the other will be a minimum. The longitudinal bars of the cylinder E constitute the conductors of closed circuits within the influence of both fields and, by reason of the displacement of the two fields when any bar is in the position of maximum inductive effect with reference to one field it is in the position of maximum torque in the other, and these conditions alternate with the result of maintaining the cylinder in rotation.

As the velocity of rotation is dependent in part upon the difference of phase between the currents in the two coils or sets of coils C and D, the instrument will register only the effective coulombs or joules, and not merely apparent current or energy. The instrument in order to work properly should be so adjusted that the speed of rotation should always be well below that of synchronism.

Mr. Samuel B. Van Raust, for many years an electrician with the United States Illuminating Company, has been given leave of absence for three months to go to London and take full charge of placing the electric light in Mr. Augustin Daly's new theatre now being built in Leicester Square. His principal work will be designing and building the switchboard table and wiring the stage. Mr. Van Raust is well adapted for this work as he has made a special study of theatre lighting for a long time. The artistic lighting which has appeared at Daly's, Palmer's, the Academy of Music and the Casino from time to time was of his original designing. He did some very beautiful work recently at the German Liederkranz Club.

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Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
Western Editor and Manager, L. W. COLLINS. 575 The Rookery, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 501 Girard Building, }

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

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MONOPOLY?

WHILE a depressed and unsatisfactory condition of electrical business still attends the conflict between the General Electric Company and "the field," it is apparent that there has been an abatement of the apprehension and alarm felt by electrical manufacturers and dealers lest a gigantic monopoly of the industry was about to be established to their exclusion and the ruin of their business.

THE ELECTRICAL ENGINEER has always held, and still holds, that a comprehensive and permanent control of electric light and power could never be concentrated in a single organization—for reasons that we have several times stated. But while we have no doubt of the ultimate result—no doubt that the manufacture and sale of electric lamps, dynamos, motors and accessory apparatus will be as free to the competition of merit and cheapness as are now the manufacture and sale of steam engines and machine tools, for instance—yet, we think, the position of advantage held by the General Company at present is such that a too optimistic view of the near future, on the part of other manufacturers and dealers, may lead to a false sense of security. The General Electric Company will doubtless try to avail itself of every legal right it possesses, through the protection of the Edison patent or otherwise, to make the largest possible return upon its investments; should it not do so it would be false to the law of its being. Neither howling and dancing like dervishes nor beating of tom-toms will dissuade its managers from any policy that they deem conducive to the largest obtainable profits. Nor can its intentions in this regard properly be called nefarious. The contest is simply between the "ins" and the "outs" at present. If the "ins" have the advantage just now it is under the rules of the game—the patent law and other laws of the country. Under our existing conditions of business and of law combinations for monopolistic purposes are as likely events as a visitation of cholera under existing sanitary conditions in some parts of the world. They come about through the natural workings of motive and opportunity under circumstances that permit their developement; they are incident to our present state of commercial growth. This is not to say that they are good things and that they should be accepted as necessary. They should rather be contended against with every legitimate weapon till conditions can be achieved that will make them impossible.

To-day the condition is a very practical one as between consumers and the general trade on one side and the General Company on the other. Too great significance may easily be attached to the remark of Mr. Fish, the general counsel of the company, quoted in the symposium on the "Lamp Situation" by *The Electrical World* of last week, that "he did not think that it was possible for the General Electric Company to control the lighting industry of the country, as some feared, nor had that company any intention whatever of attempting to do so." We believe Mr. Fish sincerely entertains the above opinion, but doubt much whether it will guide the directors of the company in their policy if they succeed in closing up all outside lamp-makers by injunction under the Edison patent. Pending this result, the General Company, through its licensed selling agencies, does not refuse, in the last resort, so far as we know, to sell lamps for use on plants, old or new, employing dynamos and apparatus other than of their manufacture; but they are careful to state—and Mr. Fish reiterates it—that such sales are not to be regarded as precedents. This is obviously a very rational procedure so long as several outside sources of lamp supply remain open to purchasers; but its continuance may well be doubted if the General Company be successful in closing up the lamp factories that are still doing business.

What we wish to point out is that no miracle is likely to intervene for the protection of electric lamp-makers or electric supply dealers as against the interests of men so astute and skillful as the managers of the General Electric Company. It is gratifying to learn that earnest and promising efforts to produce non-infringing lamps are well under way in many shops and to believe that some of them will be successful. The Edison patent has about a year and three quarters to run, apparently; a period within which a variety of new and good lamps are likely to be produced, unless our faith in American inventors is misplaced.

A valued correspondent expresses to us his belief that eventually the manufacture of incandescent electric lamps will become so free an industry that they will be found on sale in hardware and house-furnishing stores, as lamp chimneys are now; and that then a trade-mark—certifying quality—will be of more value to a manufacturer than any lamp patent. Those lamp-makers who accomplish most in improvements and in cheapening cost during the next year or two will be nearest to possessing the best trade-mark, and perhaps some good patents as well. It is very well to pray; but keep your powder dry, too.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC RAILROADS.

BY

Jno. C. Henry

In reviewing the past development and the present practice of electric railroading, many object lessons have presented themselves, some of which, at this day, seem to have escaped attention. It is the purpose of this paper to draw attention to some of those features, and to indicate the direction wherein further reliability, economy and convenience may be found. In considering these matters, we are not unmindful of the fact that electric railroading has progressed more rapidly than any art in the history of man—and this in the face of stupendous difficulties and prejudices which seemed to obstruct every effort.

Quite recently a radical change has been made in the products of the principal motor manufacturers. The single reduction, iron-clad motors, have been pushed to the front. The influence hastening this was, doubtless, the exhibition at the Buffalo Street Railway Convention, of such a machine by threatening competitors; it attracted much attention. The street railway managers who were irritated by the noise and its attending expense in the old style of double reduction machines prayed with the old maid: "Oh, God, anything but this!" Whether the change is for the best may still be an open question; theoretically, it is a retrograde step. As is well known, to get the best results from electric motors they should be run at a high speed, and adding to their weight increases the non-paying load on the cars. In the double reduction motors, the leverage between the armature and car axles was ten to one. In the single reduction machines it is less than half, or about four and a half to one. It is obvious that to deliver the same power on the car axles with the single reduction machines, the torque or twisting power of their armatures must be doubled. This result has been obtained by increasing the weight and improving the design, mainly in getting a closer magnetic circuit. If the single reduction machines of to-day were driven at the speed of the double reduction machines they would develop thirty, instead of fifteen horse-power, and do it with greater economy in current consumption. This can readily be accomplished by changing the gear to suit the required car speed, and increasing the electrical pressure. With the armature speed the same in both cases, the new motors should have really double the capacity of the old ones.

If such a practice is not permissible, owing to the heating of the armatures, which, I suspect, would be the case, it is an indication of defective design. I have had an opportunity of building and testing quite a number of different forms of railway motors. My impression is that for variable work high efficiency cannot be maintained when the armature core has projections. I have made and used some such, which were very efficient at certain speeds; they were strong pullers, but they absorbed nearly the same amount of energy when running light as they did when loaded.

In attempting to account for this phenomenon I was led to the conclusion that they were synchronous machines, and although they would work out of phase, when doing so, some resisting influence had to be overcome, which decreased their efficiency. It then occurred to me that abrupt changes of magnetization or of current would produce a secondary effect which, unless turned to assist, will work against translating devices. In a railway circuit a dynamo is the controlling member; the motor responds to its impulses. The more abrupt those influences are, the stronger the secondary effects. When the motor armature projections respond in phase with the dynamo commutator, whatever secondary effect there may be, it is in the direction of useful work, but when the machines are running out of unison, trouble begins, and increases with the variations of speed between them. A mechanical analogy may be made with two machines geared and belted together; if the teeth or belt slip, there is a loss by friction. With synchronous machines they may be imagined to be magnetically geared together.

For high efficiency, dynamos or motors should have perfectly smooth cores. They should be run at as great a speed as safety will permit, and have the greatest possible number of sections in their armatures. Every departure from these requirements is in the direction of lower efficiency and consequent injuries from heat. If the stability and weight efficiency of motors demand projections on the armature cores, they should be carefully rounded and placed as close together as possible; in other words, when dealing with direct current machinery, magnetic abruptness should be avoided. In alternate current dynamos and synchronous motors the rule should be reversed, as their action is dependent on magnetic abruptness and rapid reversals.

My opinion is, electric cars require but one motor. This should be mounted on a single-ender car, in view of the motorman, the armature of which should run constantly. The double-reduction motor has been condemned mainly on account of the disagreeable howling noise it at times produces, which was evidence of the destruction of its moving parts. What caused this peculiar noise was a puzzle to me for a long time. I faced the annoyance until the truth finally dawned upon me; then the remedy was easily supplied. Properly cut gearing cannot howl or roar if the teeth are prevented from bottoming or wedging. When the shaft springs or the bearings are worn, either or both of these objections occur; the fault is purely a mechanical one. The remedy is to use friction rollers between the shafts. With it many of the advantages of the slow speed machines disappear, as the wear on the bearings and gear is the same in both machines; decreasing the speed half and doubling the pressure against the gear teeth does not decrease the wear. Thirty horse-power motors that do not weigh over 2,500 pounds, are within easy reach. We have reports from motors used abroad that weighed less than eighty pounds per horse power developed. We have ourselves made and used others that weighed less than fifty pounds to the horse power developed.

If a street car requires thirty horse power to do the work, and this can be got in a thoroughly practicable way from a motor weighing, say, 2,500 pounds, what is the use of loading the car and pounding down the track with additional machinery weighing from 5,000 to 8,000 pounds, as is now the practice? A popular and fallacious idea, which I have repeatedly heard and for a long time believed simply because everybody said it was so, is that you need the weight to assist in the adhesion. This might apply in the suburbs where trail cars are permitted; but where the requirements of a self-contained car are considered, adding to the weight increases the cause of slippage just as much as it increases the remedy; hence a car loaded down to the guards will slip on a bad rail just as much as an empty one. Indeed, if there is any difference, the indications seem to be in favor of the empty car. I am aware there will be many doubters on this point, but let them try it. You will notice a trained engineer or motorman will invariably throttle his current or steam when his driving wheels slip. In doing so he decreases the power of the motor; in other words, he decreases the tendency to slip. Adding weight demands more power to move the load; the slipping tendency increases with the efforts of the motor.

While on this subject of adhesion, I will refer to an interesting demonstration I made some time ago on the Rochester road, which I confess surprised me at the time. We were experimenting with a thirty horse-power motor mounted on a swivel truck; it was connected with both axles by a connecting rod driven from its center. The car body was supported on this truck at one end, and by a pair of idle wheels and pedestals at the other. The wheel base was 13½ feet. Contrary to the advice of car builders, I had previously found this construction permissible where the curves were not less than 40 feet radius. The car body and loads were the same as on the other cars on the road, which consisted of the ordinary four wheel, double motor car equipment. In this case the load was equally distributed on the four wheels. In our case but one-half of the load rested on the motor truck. To all appearances we slipped less than the other cars. This proved conclusively to me that there was an advantage in connecting the car axles together. A peculiarity of this truck was its rigid frame and short wheel base. I am decidedly of the opinion that such a construction is easier on the track than where the axles are flexible vertically. In the latter case the wheels conform to the surface of the track and strike the low joints with a blow; with the rigid frame the wheels are held in the position the track should be. If a low joint is encountered the wheels really pass over without touching it; first one forward and the two rear wheels carry the load. As soon as the idle forward wheel passes the depression, the rear one on the same side is held up by the frame. This advantage applies more particularly where the pivot is central between all of the four wheels. A truck that does not pound the low joints and jar the car is a very desirable thing.

My conclusions, which are based on months of close observations, are thought to be worthy of consideration. Some time ago

I noticed an article written by a well-known car builder. It referred to the horse cars on the Broadway line in New York City, and stated that there was a difference of 2,000 pounds in the weights of the separate makes of cars; and that it costs two cents per ton per mile to haul this superfluous weight. A close comparison of the cars, which to the ordinary observer are alike, and a study of different railroad expense statistics, satisfied me there was no great mistake in the statement. The same statistics, applied to many of the electric roads, would indicate senseless extravagance of a high degree. The omnibus is constructed to shelter passengers and stand the vibrations incident to a rough road. It is built as commodious and light as possible. Sleeping cars are built to stand high speed, to roll over embankments without breaking to pieces and to stand the jerks and kicks of a 1,000 h. p. locomotive. The modern electric car is a cross between the two. In the construction of street cars, which are required to stop and start frequently, to lift themselves up hard grades, I think the lines of the omnibus should be observed, more particularly so in the roofs. If they are light the walls and floor may also be so.

I scarcely need call attention to the fact that the tendency seems to be to build street cars on the lines of sleepers. As a result one of them weighs double as much as the other car bodies of the same capacity. We need not go far from home to make the comparison. The city of San Francisco led the way in mechanical street car traction. I think they have the most commodious, safe and convenient style of cars made. I have found them admirably adapted for electric motors. They are known as combinations. The earliest built were remodeled horse cars. The managers took the ordinary 14-foot horse cars, removed the platform and hood from one end, and built a light 14-foot addition thereto. The new part was open with a passageway through the centre for the conductor and gripman. The passengers face outward in the open part; the gripman is located well forward in the aisle without even a shadow to obstruct his vision. The car body, which weighs but about 7,000 pounds, is mounted on light, double, 26-inch wheel trucks. These cars are provided with track brakes, the shoes of which keep the rails as clean and bright as silver. During rush hours on one of the lines they run under a 20-second headway, and in a pinch will carry 120 passengers to the car. They run on a 37-pound girder rail, the joints of which require but little attention. These cars weigh, empty, between 10,000 and 11,000 pounds. Their weight is distributed on eight wheels; taking the maximum estimate of their weight makes the weight on each wheel but 1,375 pounds. By adding a 30 h. p. motor, locating it on the forward trucks, we would distribute the weight equally on the eight wheels and have a pressure of less than 1,700 pounds to each wheel. There are in service in many places to-day four-wheel electric street cars that weigh, empty, not less than 10 tons. Their wheel pressure is 5,000 pounds or nearly double that of standard freight cars. There is a law known to mechanics, which can be demonstrated mathematically, that the destructive effect of rolling loads at the same speed is as the square of the weight. By applying the law in our comparisons we find the four-wheel car referred to injures the track seven times as much as the style of car I advocate. Those who are now using 60-pound rails and who wish they were 90-pounders, will do well to carefully consider this comparison. Where the rolling stock is properly designed and the joint ties are supported on concrete, a 35-pound girder or T-rail is all that is necessary for ordinary street railway purposes.

It will be observed that although the combination car has nearly double the carrying capacity of the four-wheeler referred to, the complete equipment would weigh about 3½ tons less. If our estimate is correct that it costs two cents per ton per mile to move this surperfluous weight and the mileage is but 100 per day (which is below the average of electric cars), there would be a direct saving in favor of this equipment of $7 per day which would amount to over $25,000 per car during a period of 10 years. Several years ago in the city of San Francisco there were so many accidents on the roads operating trail cars that popular sentiment compelled the aldermen to pass an ordinance requiring all roads operated by mechanical power to use the combination pattern of cars. They have also met with favor in Kansas City, Chicago and elsewhere. I have said such cars were peculiarly adapted to electric motors, owing to the location and position of the seats in the open part—*i. e.*, facing out, and the conductor's passageway—the motor can project through the floor, keeping it away from the mud, dust and slush or snow on the streets, and at the same time be in the view of the motorman. They would need but one instead of two fenders, brooms, brake levers, headlights, reversing switches, sand boxes, controlling switches and conductor bells. The car bodies with 26-inch wheels would set low, which would add to their convenience and safety. By following the line I have indicated, any respectable horse railroad can be reconstructed for half the money it commonly costs. The cars will be easier to operate because they weigh less. They will be less expensive to keep in repair because they are stripped of much of their paraphernalia.

If the cars are required to stop and start frequently and do their work on grades, by using a constant-running armature the fuel consumption and sudden strains can be reduced nearly one-half. I expect some of my electrical friends would take exceptions to this statement; but I believe it to be true nevertheless. I followed this practice for several years in the operation of some of the early electric roads, and have since had an opportunity of making careful comparisons with the most popular machinery, and am still of this early-formed opinion.

To be better understood, I will briefly explain the advantages of a constant running armature. Suppose we overload one of the ordinary electric cars so that the armature cannot turn. If the dynamos are constant potential machines, such as all roads are supposed to have, and if the feeders have sufficient carrying capacity, the motors will absorb probably over 200 h. p. Their efficiency will be *nil*, because they are doing no useful work. If the load is reduced or the leverage is changed so that the armature can turn, say, 500 revolutions per minute, the efficiency would be increased from 0 to about 75 per cent. In other words, the slower an armature turns the more current it absorbs and the less actual power it develops. With fixed armatures it requires as much power to stop the machinery as it does the car. Where the brakes are applied suddenly, the strain on the armatures, gears, bearings, etc,, is tremendous. To assist in starting, it is of great advantage to preserve the momentum of the armatures and have them do their heaviest work when their efficiency is the highest, instead of when it is the lowest. On descending grades the armature can be disconnected. The car will then run freely without current. Such an equipment requires no rheostat or current wasting devices, which are common with all the well known systems. This problem of a variable speed changing mechanism, or, in its absence, a reliable fast and loose connection, is worthy of the steel of the foremost mechanical engineer. He will find that the ground has been cultivated some, but still there is room for improvement.

While the series multiple method of regulation is much more economical than the old series rheostat method, the former is not perfection, by any means. Theoretically, it cannot campare with a shunt motor, where the fields may be weakened or strengthened without changes from artificial resistance in the armature circuit. But in practice there are objections to the use of such a machine, particularly so on railway circuits. As the field magnets require and deal with but a very small proportion of the energy absorbed by the motor, they are necessarily wound with very long and delicate wires. This gives a sluggish action to the magnets' excitation. When the trolley wheel bounds away from the wire, or a switch is thrown, the circuit is momentarily broken. On being closed, the armature short circuits the line until the sluggish-acting magnets have time to excite themselves and repel the circuit in the armature by self-induction.

Another serious objection to shunt motors for railway work is the difficulty of insulation, to protect the magnets from the secondary spark which appears on breaking the circuit. On a 500-volt, 15 h. p., shunt motor, this piercing tension would be many times greater than the electrical pressure on the line, as it is well known to increase with the resistance and size of the magnets. To arrive at a perfect system of regulation, and avoid the objectionable features of the shunt motor, I have proposed a plan which, at first sight, may appear a little cumbersome. It is to separately excite the motor field magnets from a few storage cells carried on the car. I estimate that for ordinary work about ten cells will answer the purpose. The plan certainly insures the field magnets from ever being injured, and, at the same time, avoids all losses caused by any of the present methods of regulation.

ELECTRIC RAILWAY EXTENSION IN CHICAGO.

At a recent meeting of the directors of the Chicago North Shore Street Railway Company it was decided to increase the capital stock of the corporation from $500,000 to $650,000 and the issuance of $1,500,000 of bonds was authorized.

It is now positively asserted that the surface road which is to connect Chicago with Evanston will have its southern terminal in the heart of Chicago. An entrance will be made over elevated tracks and a 5-cent fare charged for one continuous ride within the city limits. From Evanston, however, a 10-cent rate will be asked.

Immediate efforts will be made to get the consent of the property-owners for such a system of transportation in the city, and as soon as possible an ordinance will be asked of the city council. It is not believed that any difficulty will be met in pushing the enterprise to completion. Among the large stockholders are John J. Mitchell, Marshall Field, J. W. Doane, Charles L. Hutchinson, J. L. Cochran, A. D. Wheeler, D. H. Lauderback and many others equally well known.

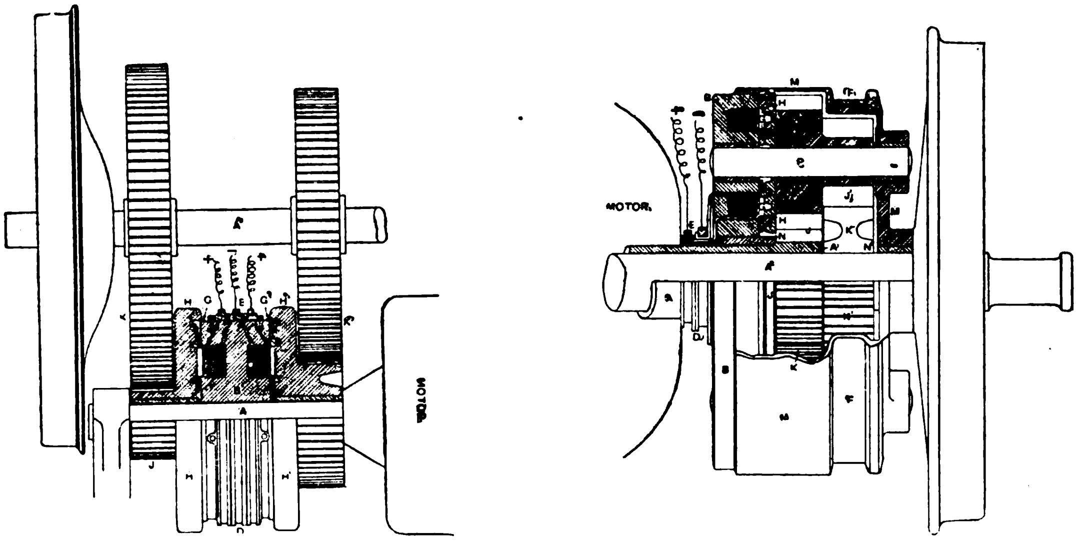
There is still another plan to give the North Side rapid transit by means of an elevated road. The franchise is sought by the Chicago North Side Elevated Railroad Company to build a main line and two branches through the North Side business and residence districts. Starting from a down-town terminus at a point from which connection with the proposed loop will be available, the road will extend to the north city line.

Under the ordinance the company is compelled to acquire land between the boundaries named, but it is said the intention is to use alleys as far as possible. The right to build bridges over the river will also be granted.

THE BEAUMONT VARIABLE ELECTRIC CAR GEAR.[1]

THE accompanying engravings represent two forms of variable electric car gear designed by Mr. W. Worby Beaumont, of London. In one of these, Fig. 1, A represents a motor shaft, and A^{2} a car axle arranged as for single reduction gearing. On the motor-spindle is fixed a double-faced disc magnet, B, current being sent into either of the two energizing coils through the conductors + + and the return conductor —, according to which side of the magnet it is desired to use. On either side of the double magnet are pinions J and J^{1}, connected to the keepers H and H^{1}, the pinions running loose upon the shaft of the motor and gearing with the wheels K and K^{1}, the one or the other, as may be desired. In starting a car, current would be sent through the left-hand coil by the conductors + —, and a brush E, resting upon one of the collector rings D. The keeper H would thus be drawn to and held by the magnet, the frictional hold being increased by the use of the pole-pieces or rings G, with annular projections fitting into grooves in the armature. The small pinion J will thus be clutched to the magnet, and thereby to the motor shaft, and the car-axle A^{2}, will be driven at a speed corresponding to the ratio subsisting between the diameter of the pinion J and the wheel K. This in the diagram is a ratio of 4 to 1. The car having been started, or having ascended a hill by this means at the slow speed (the motor running at full speed), may now be driven at the higher speed due to the larger pinion J^{1} and smaller wheel K^{1}, by cutting the current out of the left-hand coil and sending it through the right-hand coil, The keeper H is thus allowed to run loose upon the motor-spindle and the keeper H^{1} is fixed to it, and the car will now be driven at the higher speed. This, in the case shown, would be double the lower speed.

As there are several arguments in favor of direct driving of cars or locomotives by armatures on the driving-axles, an arrangement of gearing for this system has been designed, and is shown in Fig. 2, partly in section. In this case the maximum speed is that of the motor, the shaft of which, A, is hollow and is mounted and runs upon the shaft to be driven, A^{2}, namely, the car or railway-axle. Upon the hollow motor-shaft A is fixed a pinion, J, gearing into an idle wheel, K, carrying, a pinion J^{1}, which gears into the wheel to be driven K^{1} fixed to the shaft A^{2}. Fixed upon one face of the idle wheel K is an annularly-grooved disc-keeper H, into which the rings G, G on the pole-pieces of the disc-magnet B fit, forming a magnetic clutch. Two such clutches are employed in the arrangement shown. Current for energizing the coils of these magnets is supplied through the conductors + — the brushes E and collector-rings D. By means of these magnetic clutches so formed, the idle wheel K and the connected pinion J^{1} may be held fast, and when this is done the shaft A of the motor the whole of the gearing and containing case are locked together, so that the speed of the driven shaft becomes that of the driving shaft. For starting an electric car or locomotive, current is cut out of the coils of the magnets B B, and is instead directed into a magnetic clutch-break, not shown in Fig. 2, except in so far as the clutch-break band is shown in section at F upon a part of the case M, which is made circular for the purpose. When this clutch-break, F, is in action, the case M is held fast, and the idle wheel K revolving with the spindle P drives the car-axle A^{2} at a speed which is proportional to the dimensions of the gearing. In the example shown, the motor shaft A would make two and a half revolutions to one revolution of the car or locomotive-axle A^{2}. It will be seen that for ordinary running—that is to say, after starting and when not climbing a hill, the whole of the gearing is inactive.



FIGS. 1 AND 2.—BEAUMONT VARIABLE ELECTRIC CAR GEAR.

MISCELLANEOUS.

ANNUAL MEETING OF THE AMERICAN BELL TELEPHONE COMPANY.

THE annual meeting of the American Bell Telephone Company was held in Boston on March 28. The report of the directors for the year ending December 31, 1892, was submitted by the president of the company, Mr. John E. Hudson. The report begins with the statement that the year 1892 was marked by a considerable increase in business, and that the extension and improvement of the plants of the companies operating under the company's licenses, as well as of the improvement of the service, have been most satisfactory. The instrument record shows that on December 20, 1892, 552,720 telephones were in the hands of licensees under rental, an increase of 40,313 over the same date in the previous year.

From the table of exchange statistics it is learned that the total number of exchanges was, on January 1, 1893, 812, a gain of 24; that the number of branch offices was 539, a gain of 30; the wire mileage on poles 201,259, a gain of 21,120; the wire mileage on buildings 14,980, a gain of 26; the mileage of wire underground 90,216, a gain of 19,882; the mileage of submarine wire 13,336, a gain of 307; and the total wire mileage was 307,791, a gain of 41,335. It appears that the total number of employees increased 1,594 during the year bringing the total up to 9,970, and that the whole number of exchange stations, which is practically synonymous with subscribers, was on January 1, 1893, 232,140, a gain of 16,123 during the year.

The estimated number of exchange connections, ascertained largely by actual count, is 1,868,189 daily, or about 600,000,000 per annum.

The number of daily calls per subscriber varies in different exchanges from 2 to 17, the average throughout the United States being $8\frac{1}{20}$, showing an increase from last year in the average use made of telephone by each subscriber of 10 per cent.

The average cost to the subscriber varies from less than 2 to 11 cents per connection, according to the size of the exchange and the character of the service.

The wire mileage of extra territorial lines, which are lines connecting exchanges, on January 1, 1893, was 133,002, an increase for the year of 17,914.

The average number of toll connections per day is reported at 40,772, or about 13,000,000 yearly, and the total toll revenue was $1,897,258.33. To this is to be added $643,436.77, the gross earnings of the American Telephone and Telegraph Company, commonly called the Long Distance Company.

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[1] The *Electrician*.

The earnings of this company in 1892, as given above, $643,496.77, exceed those of the previous year by about 50 per cent.

The detailed statement of underground constructions shows that it exists in 33 cities in the country, and that Boston stands third in the mileage of telephone wire underground, being exceeded in this respect only by New York and Chicago.

LEDGER BALANCES.

FINANCES.

The ledger balances for Dec. 31, 1892, are given as follows:

DEBTORS.

Telephones	$1,133,900.39
Real estate	950,976.61
Stocks	34,120,795.56
Merchandise and machinery	14,440.73
Bills and accounts receivable	3,781,747.52
Cash and deposits	2,365,419.10
Total	$42,367,279.91

CREDITORS.

Capital stock	$17,500,000.00
Debenture bonds, 1888	2,000,000.00
Bills and accounts payable*	1,334,515.76
Patent account (profit and loss)	10,169,924.75
Profit and loss	5,684,104.97
Reserve	3,357,722.82
Surplus	2,151,011.61
Total	$42,367,279.91

*Of this amount $1,050,000 was for dividends payable Jan. 15, 1893.

EARNINGS AND EXPENSES.

The detailed statement of earnings and expenses is as follows:

EARNINGS, 1892.

Rental of telephones	$3,303,753.10
Dividends	1,422,047.98
Commission on ex-telegraphic lines	101,806.32
Commission on telegraphic business	29,417.31
Real estate	67,363.14
Interest	168,830.22
Miscellaneous	7,668.57
Gross earnings	$5,100,886.59

EXPENSES, 1892.

Expenses of operation	$378,272.89
Legal expenses	87,767.28
Real estate	85,666.19
Interest and taxes	279,638.96
Commission	648,689.25
Royalty	10,000.00
Concessions	246,914.53
Miscellaneous	2,262.74
Expenses	$1,689,211.81
Leaving net earnings of	$3,411,674.78
Adding surplus, Jan. 1, 1892	2,151,011 61
Total	$5,562,686.39

This amount was appropriated as follows:

Regular dividends, 1892	$1,927,227 00
Extra dividends, 1892	991,863.00
Reserve, general depreciation	400,000.00
Reserve, depreciation of instruments	92,584.78
Surplus accounts, Dec. 31, 1893	2,151,011.61
Total	$5,562,686 39

Attention is called to the fact that only one of the past eight years shows so large an increase in the number of exchange stations reported by the operating companies. The report continues:

And not only has there been a large increase of subscribers, but an interesting feature of the statistics, of which mention has been made in earlier reports, is the increase of the daily use, by each subscriber, of the local exchange service.

In 1892 the average of use was greater by 10 per cent. than in 1891, being least in the small exchanges, and following a fairly well graduated scale of increase to the highest average, which is found in the large cities. In 1886 the total number of exchange connections per annum was computed at 312,605,000. In 1892 it is estimated to have been 600,000,000. The general average of such connections originating at each station is 8 1-20 per day; that is, each subscriber, on the average, is placed in communication upward of 16 times with others in the same exchange, as compared with an average of 11.6 times, which was the record of six years ago.

The large addition to the number of subscribers for metallic circuits is noted with gratification, as a proof of the appreciation of the advantages which this class of service is found to afford. At the beginning of the year the metallic circuit equipment numbered 11,584, and at the close of the year they numbered 23,053.

Concerning the criticism which has at times been made that the rates at which the service is furnished in the larger cities are disproportionately high, as compared with those charged in smaller exchanges, the report says: "Setting aside the consideration that, in the larger city, containing some thousands of exchange stations, the use made by each subscriber, and the value to him of telephone facilities must inevitably be much greater than they would be in an exchange of less importance, it is also the fact that in exchanges above the limit of a few hundred subscribers, the cost of maintaining and operating each station bears a close relation to the numerical size of the exchange and the extent to which each station is used, rising in the largest cities to an amount several times as great as the cost in the average of the small exchanges.

"The necessity of bringing the service to the highest attainable standard of excellence to meet the needs of a great business community; of employing a corps of the best skilled officials large enough to meet any probable emergency of the service; the higher rates of wages, rents, taxes and transportation which prevail in the larger cities; the expensive character of construction and maintenance inseparable from the conduct of business in densely populated sections, where proximity with electric light and power currents is difficult to avoid, combine to enhance the cost to the company operating the exchange."

Reference is then made to the "long distance" work already so fully noted in our columns. The passages close as follows:—

"It is noticed as an interesting fact that within that territory live and do business more than 50 per cent, of the whole population of the United States, so that it is no figure of speech to say that more than one-half of the population of the country are within talking distance of each other."

"In building these lines, in bringing the existing plants up to the level of the latest knowledge, in adapting them for use on so extended a scheme, and in yielding to the public demand in the more thickly-settled portions, of the large cities that the wires should go under ground—in these various branches of work more than $35,000,000 have been expended, principally within the past six years."

The question of litigation is next taken up.

In the last annual report it was stated that the long pending application of Berliner for a patent for the microphone, an invention acquired by the predecessors of this company in the early days of the phone, had been allowed by the commissioner of patents, and that the patent had issued to the company bearing date Nov. 21, 1891.

This year the report states that the Edison application for a patent for the carbon telephone has also finally met with success, and resulted in patent No. 474,231, granted to the Western Union Telegraph Company, as assignee of Edison, May 3, 1892.

The carbon telephone patent will be controlled by the American Bell under its agreement with the Western Union.

It is added, however, that Edison's foreign patents for the same invention, although applied for subsequently to the application in this country, had expired previously to the grant of the American patents.

The company is advised by counsel that the law is unsettled whether in such cases the application should be defeated by the expiration of the foreign patent, but that the better opinion is that the fate of the foreign patent is immaterial.

Concerning the expiration of Bell's first patent the report says:

"The expiration on March 7, 1893, of United States patent numbered 174,465, issued to Prof. Bell, occasioned some confusion in the public mind, owing to the fact that it was not clearly understood that Prof. Bell's patents were two in number, the second of which. numbered 186,787, dated Jan. 30, 1877, will continue in force until Jan. 30, 1894. The subject matter of this patent was defined as follows by Mr. Chief Justice Waite, in giving the decision of the supreme court of the United States in the telephone cases (126 United States Reports. 572):

> "The patent itself is for the mechanical structure of an electric telephone to be used to produce the electrical action on which the first patent rests. The third claim is for the use in such instruments of a diaphragm, made of a plate of iron or steel or other material capable of inductive action; the fifth, of a permanent magnet constructed, as described, with a coil upon the end or ends nearest the plate; the sixth, of a sounding box as described; the seventh, of a speaking or hearing tube as described for conveying the sounds; and the eighth, of a permanent magnet and plate combined. The claim is not for these several things in and of themselves, but for an electric telephone in which these things or any of them are used."

An impression has gained some currency that the patent upon the Blake transmitter expired on the 20th of January, 1893, because of the expiration on that date of certain foreign patents which were taken out on Mr. Blake's invention. But Mr. Blake's original application was filed in the United States before any application abroad, and, under these circumstances, although the Supreme Court has not passed upon the question, it is considered the better opinion that the Blake patents are still in force.

The government suit against the American Bell Telephone Company and Alexander Graham Bell still continues. The defendants have until Jan. 25, 1894, to complete their evidence, should they wish so much time.

In the matter of the new suit brought by the government against the Bell company and Emile Berliner the report says:

"One of the latest acts of Attorney-General Miller before retiring from his office was to institute a suit to annul the Berliner patent. For that purpose on Feb. 9, 1893, the government filed its bill of complaint in the circuit court of the United States for the district of Massachusetts. The bill charges particularly that the original application did not cover the microphone, but was only made to do so by unlawful amendments, that Berliner was not the original and first inventor of the microphone, and above all, that the progress of the application in the patent office was wrongfully delayed."

In the course of proceedings the brief or argument which had been filed with the attorney-general, and on which he was asked to take action, was sent to the interior department and the patent office for consideration and report. The commissioner gave the matter exhaustive examination, and said in conclusion:

"I do not believe that a suit to repeal this Berliner patent is justifiable."

This report was sent to the honorable Secretary of the Interior, who, in turn, sent it to the attorney-general with a communication containing an expression of his own belief that Berliner's was the mind that made the invention covered by the patent; that the amendments complained of were made in due course, and that there were no extraordinary delays in the prosecution of the patent imputable to Berliner or his representatives.

"I am advised," says President Hudson in conclusion, "that it is without precedent for the department of justice to bring a suit to annul a patent without first obtaining from the department of the government from which the patent issued an expression of opinion that the suit ought to be brought."

A ballot for clerk resulted in the re-election of Mr. Charles Eustis Hubbard, while Mr. William R. Driver, the present treasurer, was also elected to succeed himself.

The election for directors resulted as follows, there being no contest: Thomas B. Bailey, Francis Blake, Charles P. Bowditch, George L. Bradley, Alexander Cochrane, William H. Forbes, Henry S. Howe, Charles Eustis Hubbard, Gardiner G. Hubbard, John E. Hudson, Charles E. Perkins and Thomas Sanders.

It was voted to increase the capital stock from $17,500,000 to $20,000,000, and that for each seven old shares the holder shall be entitled to one of the new issue. It was recommended that the stock be issued, one-half on July 20 and the other half on Oct. 20, when the meeting adjourned. A meeting of the directors was called at 12 o'clock, when Mr. John E. Hudson was re-elected president for the ensuing year, and the recommendation regarding the time when the new stock shall be issued adopted.

THE DESROZIERS CONTINUOUS CURRENT DYNAMO.

WE present this week an illustration from *Engineering* of a type of dynamo which possesses some features of marked originality, and which has been making rapid strides in the estimation of electrical engineers and the public on the Continent.

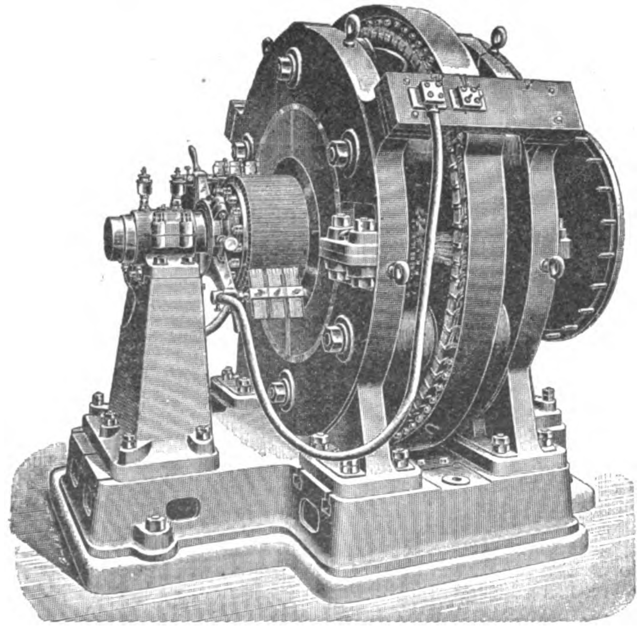
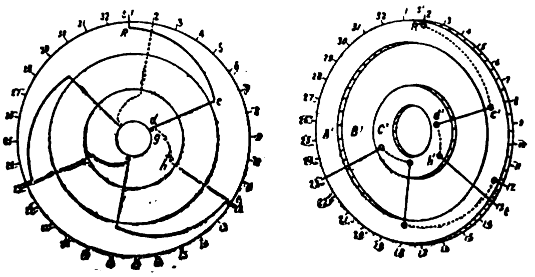


FIG. 1.—DESROZIERS CONTINUOUS CURRENT DYNAMO.

The inventor of this machine is M. Edouard Desroziers, Ingénieur des mines et expert près le conseil de la Préfecture de la Seine, well known in connection with electric lighting and traction enterprise in France, where the dynamo we illustrate has for some years past been superseding other types in the leading central stations in that country.

A short description will suffice to indicate the striking features of this dynamo machine. Our illustration is of a 100-kilowatt machine, which, it will be seen, has the general appearance of a multipolar dynamo. The special feature is to be found in the armature, which is built up without an iron core, and which, owing to its large diameter, is well adapted to direct driving, now becoming more and more recognized as a desideratum for central station and electric traction purposes among leading electrical engineers in this country. In Fig. 2 the method of winding is shown. The core is composed of a round disc of papier-mâché, which is divided into a number of segments, 32 in this instance. Starting from a point R, the armature conductor is curved along the circumference until it reaches a segment at C, where it is passed through the perforated papier-mâché disc, and carried radially down the other side to the hub, where, at *d*, it is again threaded through the disc. It is then carried along the hub until a segment at *h* is reached, when it is brought radially up to the circumference again, and so on until the whole armature is wound. The threading of the wire through the perforated and recessed disc holds the conductor rigidly in place, thus disposing of a fruitful source of trouble in dynamo machines as ordinarily constructed. The papier-mâché is cut away, as in Fig. 3, finally, thus resulting in thorough ventilation for the whole structure, and so enabling a higher current density than usual to be employed. Stability is given to the whole by "spiders" of German silver, keyed on to the shaft, and preventing displacement of the disc and its conductors.



FIGS. 2 AND 3.

More than 45 of these machines have been supplied to the French Navy, and as many more are in course of construction, while the Messageries Maritimes and other steamship lines have adopted them largely. But it is for the purpose of central station and electric traction that these dynamos have made their special mark. Four dynamos, with an output of 640 h. p., have been installed at the central station in the Rue de Bondy, Paris, and the same number of equal power at the central station of the Nord. Fourteen dynamos aggregating 2,200 h. p. have been supplied to the Compagnie Parisienne de l'Air Comprimé for the Popp central stations in the same way. Amongst many private installations those of Baron Alphonse Rothschild and Baron Gustav Rothschild at the Château de Ferrières and the Château de la Versine may be enumerated. Many others have been supplied to the Governments and private firms in Russia and Austria. In all, dynamos aggregating about 12,000 h. p. have been manufactured by the Maison Breguet, who are the makers of the dynamo in France, and it will thus be seen that these machines are adapted for all purposes for which continuous current dynamos may be required.

The manufacturing rights for Great Britain and the English Colonies have been acquired by the Brush Electrical Engineering Company, of London, who have already some of the largest sizes of this dynamo under construction. We may add that a Desroziers machine has been placed in the Baron de Hirsch Trade School in this city, and that arrangements are going forward looking to the introduction of this machine in the United States.

THE DANGERS OF CRINOLINE.

THE following is from the New York *World* and appears to be on the subject of crinoline. We do not know what else it can refer to:

> Red, white and blue sparks, chasing one another along the downtown trolley wire, used in common by all the companies on Fulton street, between Pearl street and Myrtle avenue, Brooklyn, made a dangerous display last night, running like a red streak on either side from the Park Theatre, where it parted in two, and emitting the sparks whose variety of color evoked the admiration even of those who, at the warning of the police reserve that had been called out, ran beyond the reach of the wires that writhed like venomous serpents in the streets seeking victims of their deadly electric sting.
>
> About 10 o'clock the wire parted and there was a sound as of successive volleys of musketry. Dazzling illuminations ran spluttering over the wires. Then came a sound like a peal of thunder, and the trolley wire, dropping from its fastenings, fell to within a few feet of the street, where it was suspended for nearly 10 minutes, when it broke in sections.
>
> While the wire was hanging it had become heated until, in parts, it had expanded to a diameter of several inches. All along the block the red-hot metal squirmed in snakelike gyrations from curb to curb, sizzling in the gutters and hissing in pools between the tracks.
>
> Pedestrians rushed wildly for places of security, women staggered, blanched with fear, into adjacent stores and hallways, and there was the liveliest kind of commotion among the cabmen stationed near the City Hall. Several of the cab horses starting off driverless at a brisk gallop added to the confusion.

THE COST OF STEAM POWER PRODUCED WITH ENGINES OF DIFFERENT TYPES UNDER PRACTICAL CONDITIONS, WITH SUPPLEMENT RELATING TO WATER POWER.—II.

(*Concluded.*)

BY CHARLES E. EMERY, PH. D.

(34) The writer finally presents in columns *G* to *N* inclusive the total cost per net horse-power per year for coal at the several prices stated, first for ordinary working hours, and second for 20 hours per day for the full year. An examination of the several columns shows clearly that for cheap fuel and short hours the engines of fair economy and least cost give the most economical results when both the cost of fuel and the collateral and interest charges are considered. Such a result would be anticipated in relation to non-condensing engines, but *it is somewhat surprising to find that the compound engines of comparatively moderate price show better economy, everything considered, than the higher priced triple-compound engines*, if we reject the results shown in the last line, which, as already stated, it is believed cannot be obtained in average practice. For the 10 hours' day, with coal at $2 per ton, the lowest result is, for the assumed conditions, shown in line *I*, referring to special triple compound high speed condensing engines. Unfortunately more conditions have had to be assumed in relation to this type of engine than for any of the others. They are being made specially for electrical purposes of extra weight and with extra length of bearings, and the prices available would, with proper allowance for erection, give prices higher than stated. However, the result is very little different from that shown in lines *G* and *H* for ocmpound engines high and low speed, or even for the simple low speed condensing engine, line *F*, on the one hand or the triple compound, lines *J* and *K*, on the other. This similarity in final cost is certainly very interesting, and examining columns *H*, *I* and *J* referring to cost at $3, $4, and $5 per ton, we find that although the total cost per year increases, the relative cost for engines of different kinds varies but little. At the $5 rate the high speed compound engine, line *G*, has fallen $1.43 per horse-power per year behind the low speed compound engine, line *H*, and $2.67 behind the high speed triple compound, line *I*, on bases assumed, but the latter with its lower assumed original price and higher coal consumption is holding its own substantially with the higher priced compound engine, line *J*. The same relations practically hold for 20 hours per day with cheap coal, and it is not until we reach column *N* for 20 hours per day and coal at $5 per ton that the higher priced engines (rejecting as before line *L*) show any decided superiority, and even under these circumstances the difference is comparatively not great.

(35) The writer next presents in columns *O* to *V* inclusive the total cost per horse-power per year for electric railroad and other variable work requiring 50 per cent. extra plant to obtain the average power. In making these comparisons the insurance has been increased to 1¼ per cent., the engine renewals to 4 per cent. and the boiler renewals to 5 per cent.

(36) Attention is called to the fact that although all the costs have been raised in the latter case, the general relations have been very little modified. For short hours and low-priced coal, the medium priced engines show, if anything, still better results than on the previous basis. The engines requiring the least fuel only show to advantage for long hours and high priced coal, and even then, as will be seen in column *V*, the results for the last four lines, excluding *L*, are remarkably near uniformity.

(37–38) The writer then discusses the effect of using boilers of less first cost than first assumed and presents a comparison on this basis in Table II (not here reproduced). The result is to favor the engines requiring most fuel, for the reason that they require more boiler power for a given net power. Attention is called to the fact that the same effect would result from reducing either the cost of the coal as previously stated, or the cost of handling and firing the same.

(39) The writer states that a reduction in the cost of the numerous attachments and appurtenances necessary, or claimed to be necessary, in connection with a steam plant will decrease the interest charges generally in a higher proportion for the more economical engines.

(40) The rules adopted for calculating the various columns of Table I are shown by algebraic formulæ; the notation being in terms of the letters distinguishing the several columns.

(41) The writer discusses the losses in economy due to the use of non-condensing engines with varying loads, for the reason that the back pressure forms a very large proportion of the total resistance to be overcome when the loads are light and the expansion is limited when the loads are very heavy. The former consideration partly militates against the use of triple compound engines without a vacuum, unless the steam pressure is 200 pounds or upward.

(42–45) The writer then shows that considerable changes in either one of the various items will not greatly vary the final result. The following table is presented to show for four of the various engines referred to in Table I the distribution of the various items of cost. An examination of this table shows that the collateral charges, line 2, or the operating expenses except coal and interest are very nearly constant, or about equal to the cost of coal, line 1, for the economical engines, and decrease the percentage of saving due to economy of fuel simply by increasing the amount upon which the saving is to be applied. The interest, line 4, on the contrary, tends to neutralize the economy due to increased coal consumption and therefore makes the cost of power under ordinary circumstances, when everything is considered, substantially the same for a number of different kinds of engines showing considerable differences in coal consumption.

	Simple High Speed Non-Condensing.	Compound High Speed Condensing.	Special Triple Compound High Speed Condensing.	Triple Compound Slow Speed Condensing.
Lines of Table 1.	A	G	I	K
(1) The costs of coal at $3 00 per ton, Col. *r*, for a ten hours day are for the engines stated in the headings at the right	$19.09	$11.57	$ 9.84	$ 8.91
(2) The collateral operating expenses, excluding interest, are (Line E–line D)	$10.69	$ 9.18	$ 9.06	$ 9.11
(3) The interest charges, Col. D, are	$ 6.39	$ 5.61	$ 5.95	$ 7.30
(4) The total costs, Col. H, are	$36.17	$26.36	$24.85	$25.32

(47) The writer states that the paper should not be considered a criticism of the practice or views of others or serve to discourage the higher development of the steam engine. The investigation simply shows under what conditions the higher-priced machinery is more economical and under what conditions the saving in fuel is balanced by other considerations. In some cases other conditions must be included for a complete solution of the problem. For instance, in large steamers making long voyages economical machinery secures in addition to the saving in the cost of fuel a saving in the space required to carry the machinery and fuel and thus increases almost in a geometrical ratio the efficiency of the ships. This may not be true for vessels making very short trips or stopping a large proportion of the time in port. Reference is made to the high expenditures warranted in some mining regions where coal is very high-priced and illustrated by the remarkable work of Mr. E. D. Leavitt in this direction. The paper, however, states that the development of the great West is now so modifying the conditions that a change of policy may be initiated even at the Calumet & Hecla mines in the near future. The writer during a recent business investigation with an electrical outlook ascertained that the prices of coal in Duluth and Superior, beyond the Calumet & Hecla peninsula, are even now reduced nearly to those ruling on the seabord, due to the construction and operation of large whaleback steamers which take wheat eastward and coal on their return trips.

(48) The writer states that the considerations expressed in the paper may prevent the use of specially designed pumping engines in the future where coal is reasonably cheap and concludes that the further perfection of the steam engine will not be hindered by the general facts stated, since with the development of mining industries at great distances from coal fields the closest economy in the use of fuel will secure the best commercial results. In order, however, to secure such results for growing enterprises, electrical and otherwise, in the cities and towns along lines of communication already established, the writer believes that the field will be occupied by cheaper engines of simple construction, which, though not securing the maximum economy in fuel, will so reduce the capital upon which interest and dividends are to be paid as on the whole to represent not only better commercial policy but better engineering, because based on more complete conditions.

Supplement Relating to Water Power.

(49) The writer states that it will be impossible in connection with his paper to make a satisfactory comparison of the relative advantages of steam and water power under different conditions, but as the cost of steam power has in the paper been considered on a somewhat different basis than customary previously, he considers it important to examine the cost of water power briefly in

the same way more particularly to show what amount can be paid for the development of a water power in competition with steam power. He does not think that examples should be selected where Nature has specially favored the development of water powers at a nominal cost or where the operations of the general government have assisted the mill owners as at the Falls of St. Anthony, but that the question should be discussed under more general conditions such as have been developed on the Merrimac.

(50–52) From the paper of Prof. Swain in the census reports and testimony in various water suits, he concludes that the development of water-power on the Merrimac has cost about $142 per horse-power, to which the Merrimac owners are, however, obliged to add the greater part of the cost of a steam plant for use when there is no surplus water, and continues that it has long been known that the water power on the Merrimac has cost so much for development that could the expenditures be recalled it would be more economical to locate where coal can be obtained at cheaper rates and steam power used exclusively. Notwithstanding these considerations, however, a new water power is being developed at Sewall's Falls near Concord, which, it is supposed, however, will not be subject to the initial costs of the other large plants.

(53) The writer considers the highest allowable cost for the complete development of a water power, from the dam to the jack shaft, to be about $140 per horse power utilized on a 10-hour basis. The sum of the various items of cost such as depreciation, repairs, taxes, interest and operating expenses, he considers to be about 17 per cent of the original expenditure. If the expenditure be $140 per horse-power, such percentage represents $24 per horse-power per year or about the same as shown in the tables for economical engines and coal between $2 and $3 per ton. If there were one company to furnish the power and another to utilize it, the balance in favor of steam power would be somewhat greater. When, however, the power is used for 24 hours per day a much greater original cost is permissible.

(54) When the power of a waterfall is to be delivered at a distance, the allowable cost of actually developing the power must be decreased by that necessary to transmit the power and actually deliver it to a jack shaft at a given distance. An electric transmission is undoubtedly the most economical for such a purpose. If we add to the cost of the dynamos, that of the buildings, of the hydraulic connections to the canals, of the turbines, of the line and of the installation, and finally add the cost of the motors, so that the power is according to the assumption delivered to a jack shaft, and total cost of what may be called the "electrical transmission plant" cannot probably at present prices be put in for $140 for each net horse-power delivered, so on a 10-hour basis no expenditure could be allowed for the general development of the water power, but only for the simplest hydraulic connections to existing canals, etc. If, however, power can be sold throughout the whole 24 hours, more than double the price can be obtained for the same and this will warrant doubling the total cost of development unless a greater percentage of income is desired. As the cost of the electrical plant remains the same, the whole allowable increase may be applied to the development of the hydraulic plant, thereby entirely changing the conditions.

(55) The writer has not hesitated to recommend an original expenditure of $200 per horse-power for a combined hydraulic and electric plant near large cities, where not only the customary income due to incandescent and arc lighting and the use of small motors at high rates would be available for comparatively short hours, but where the industries were such that large units of power could be sold at remunerative prices on a 24-hour basis. Even higher costs for development would appear to be warranted in some locations, but there is no general rule on the subject. The allowable expenditure in a particular case can only be determined from calculations based on the actual conditions.

NOTE ON THE DISRUPTIVE STRENGTH OF DIELECTRICS.[1]

BY CHAS. PROTEUS STEINMETZ.

When an insulating medium is exposed to a great electrostatic stress, quite independent of its specific electric resistance at a certain E. M. F., disruptive discharge takes place, that is, a spark —followed by the arc, where the supply of electricity is sufficiently large—passes through the dielectric, and such mechanical and other changes take place therein that its resistance is practically reduced to *nil*.

To investigate this phenomenon further, especially to determine the dependence of the sparking distance upon the E. M. F., a number of tests were undertaken in the Eickemeyer Laboratory. An alternating E. M. F. of 150 complete periods per second was used. The potential was increased by means of a transformer, specially built for these tests which gave the ratios of transformation 1 ÷ 150 and 1 ÷ 300, having 20 primary turns and an iron cross-section of 29 cm.^{2} The E. M. F. was measured by a special exploring coil of 20 turns.

As electrodes or discharge plates, two brass discs of 2-inches diameter and $\frac{1}{16}$-inch thickness were used, well polished and with their edges carefully rounded off. For testing liquids these plates were immersed in liquids. The application of the potential always lasted but a short time—not over 15 seconds. Still, all the materials became more or less heated before breaking down.

The results of the tests were laid down in a number of tables, giving the thickness of the dielectric, δ in milli-centimetres, the potential difference V, in kilovolts, which caused rupture of the dielectric, and the electrostatic gradient $g = \frac{g}{\delta} = V$,

To express the results by empirical formulas, the equation of the hyperbola was first tried;

$$\delta = \frac{a\,V}{b-V},$$

which would give a finite value $V = b$, where δ becomes infinite, that is, discharge takes place into the air. This function did not satisfy the results at all, and within the range of observation, no tendency to electrostatic saturation was noticed. It would give a limiting value of V at about 79 kilovolts for air.

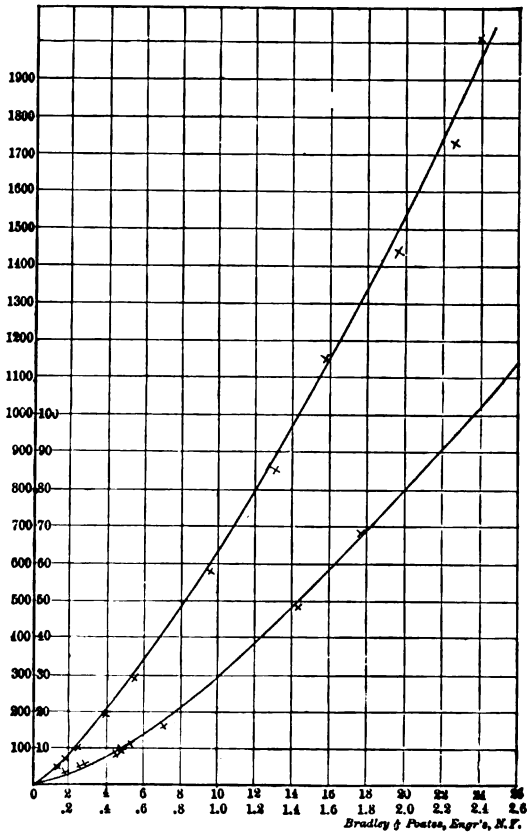


FIG. 1.

With some materials, the tests agreed fairly well with the linear function, $\delta = a\,V$, showing that at a definite electrostatic gradient, $g = \frac{1}{a}$, the dielectric breaks down, independent of its thickness. Other materials did not follow this equation at all, but the sparking distance increased quicker than the E. M. F. The addition of a quadratic term, $\delta = a\,V + b\,V^2$, gave fair agreement with the tests.

A remarkable behavior was noticed with air. For higher E. M. F.'s, the sparking distance in air agreed fairly well with this quadratic law; but even better still with a formula, where the parabola did not start at the origin, but from an E. M. F. of about 650 volts, so that these tests were expressed by $\delta = a\,V + b\,V^2 - c$.

For lower values, below $V = 1{,}500 \sim 2{,}000$, the curve left this parabola and sloped towards the origin. Consequently, to express the tests over the whole range, a further term has to be added, which disappears for values of V beyond $1{,}500 \sim 2{,}000$ volts. The simplest function of this character is the exponential $c\,e^{-dV}$, and, indeed, the tests made with air, over the whole range, were fairly well—that is, within the errors of observation —expressed by the equation,

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[1] Abstract of a Paper read before the American Institute of Electrical Engineers, New York, February 21, 1893.

$$\delta = c\left(e^{-dV} - 1\right) + aV + bV^2.$$

This equation is merely empirical and can consequently be expected to hold only within the range covered by the tests. Still, the terms of this equation may have some theoretical foundation.

The term aV gives the electrostatic gradient $g = \frac{1}{a}$, at which the air while at rest under ordinary pressure breaks down.

Mechanical or other changes taking place in the air under the electrostatic stress (for instance, air currents), and being proportional to the E. M. F., may justify the introduction of the quadratic term, bV^2.

As known, all the solid materials are covered—by molecular attraction—with a thin film of compressed air. This gives rise to the exponential term, $c\left(e^{-dV} - 1\right)$.

Very interesting luminous effects take place when a thin sheet of good insulating material, as mica, is placed between the electrodes. At a difference of potential of 830 volts and a thickness of mica of 1.8 milli-centimeters, in darkness a faint bluish glow becomes visible between the mica and the electrodes. This glow is very perceptible at 970 volts, and faintly visible in broad daylight at 1,560 volts. With increasing difference of potential, this bluish glow increases in intensity, forming a sharply defined, smooth, blue line around the electrodes at their point of contact with the mica.

At a difference of potential of 4.5 kilovolts—thickness of mica of 2.3 milli-centimetres—violet creepers of about two mm. length break here and there out of the line of bluish glow. These creepers are distinctly different from the blue glow surrounding the electrodes and increase in number and length with increasing potential, until they form a broad electrostatic aurora surrounding the electrodes on either surface of the mica-sheet, consisting of an infinite number of small violet streamers, rushing with a hissing noise over the mica. This corona increases rapidly in width until it reaches the edges of the mica-sheet. Then white sparks of intense brightness pass from electrode to electrode over the surface of the mica, first few in number, then with increasing potential, covering the whole sheet with an infinite number of streaks of lightning with a roaring noise. The amount of current passing through these sparks is exceedingly small, for no perceptible reaction upon the primary circuit was noticed. The length of these sparks is many times larger than the sparking distance in air, being tenfold at 17 kilovolts. They are intensely hot, and leave whitish marks, due to calcination, on the mica when passing over it. The sheet of mica and, especially, the electrodes become heated very rapidly, the mica twists and begins to splinter, to separate into sheets, until finally it breaks down.

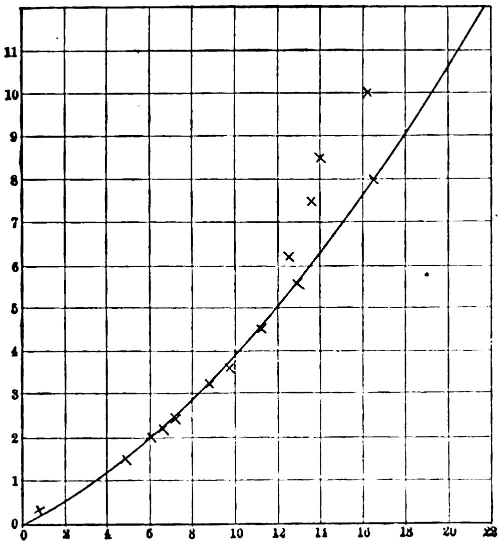


FIG. 2.

The width of the electrostatic corona is half the length of these sparks. The length of these sparks depends somewhat upon frequency and the thickness of the mica-sheet, being greater for higher frequency and thinner mica disc, but apparently only in-so-far as the capacity, or rather, the charging current of the condenser, represented by the mica disc as dielectric, is increased thereby.

From these tests, for the sparking distances through different dielectrics, the formulae were derived:

(δ in milli-centimetre, V in kilovolts.)

		RANGE
Air	$\delta = 36\left(e^{-1.3V} - 1\right) + 54V + 1.2V^2$	$.18 \leqq V \leqq 24.0$
Mica	$\delta = .24V + .0145V^2$	$.8 \leqq V \leqq 20.8$
Vulcanized Fibre	$\delta = 7.66V + 2.3V^2$	$2.2 \leqq V \leqq 22.5$
Dry Wood Fibre	$\delta = 7.66V$	$2.8 \leqq V \leqq 21.6$
Paraffined Paper	$\delta = 3V$	$6.9 \leqq V \leqq 24.8$
Melted Paraffin, 65° C.	$\delta = 12.4V$	$8.9 \leqq V \leqq 27.1$
Boiled Linseed Oil, 21° C.	$\delta = 12.5V$	$7.6 \leqq V \leqq 21.8$
Turpentine Oil	$\delta = 15.7V$	$7.1 \leqq V \leqq 15.6$
Copal Varnish	$\delta = 30V$	$9.7 \leqq V \leqq 20.4$
Crude Lubricating Oil	$\delta = 60V$	$4.4 \leqq V \leqq 15.9$
Vulcabeston	$\delta = 28V$	$4.0 \leqq V \leqq 12.6$
Asbestos Paper	$\delta = 23V$	$2.7 \leqq V \leqq 5.0$
Creeping discharge over surface of Mica	$\delta = 55(V - 2)^2$	$4.5 \leqq V \leqq 17.1$

Fig. 1 shows the disruptive discharge through air. Fig. 2 shows disruptive discharge through mica. Fig. 3 shows disruptive discharge through mica, paraffined paper, dry wood fibre, melted paraffin and air, giving a good comparison of their disruptive strength, for different potentials.

TABLE I.—DISRUPTIVE DISCHARGE THROUGH AIR.

$$\delta = 36\left(e^{-1.3V} - 1\right) + 54V + 1.2V^2$$

Maximum Difference of Potential in Kilo-Volts. V	Sparking Distance observed, in Milli-centimetres. δ obs.	Electrostatic Gradient, in Kilo-volts per cm. g	Sparking Distance calculated in Milli-centimetres. δ calc.	Difference. δ calc. − δ obs. Δ	Difference in per cent. of δ calc. %	REMARKS. $\delta = \frac{V}{65 - 29V}$	
.18	3.0	60	2.2	− .8	(−36)	3.0	∞ = δ at V = 2.2
.26	4.6	57	3.8	− .8	(−21)	4.5	
.29	5.1	57	4.5	− .6	−13.3	5.1	
.46	8.1	57	8.9	+ .8	+ 9.0	8.9	
.48	9.1	53	9.5	+ .4	+ 4.2	9.4	
.53	11	48	11.0	0	0	10.7	
.71	16	44	17.1	+ 1.1	+ 6.4	16.0	
1.43	48	30	49.3	+ 1.3	+ 2.6	(62)	
1.76	68	26	66.4	− 1.6	− 2.4		
2.46	100	25	105.7	+ 5.7	+ 5.4	First term has disappeared.	
3.96	190	21	197	+ 7	+ 3.5	$\delta = \frac{V}{17.8 - .226V}$	
5.5	287	19	297	+10	+ 3.4	(332)	∞ = δ at V = 79
9.5	575	17	584	+ 9	+ 1.6	606	
12.7	860	15	844	−16	− 1.9	852	
15.7	1150	14	1110	−40	− 3.6	1097	
19.6	1440	14	1480	+40	+ 2.7	1457	
22.6	1730	13	1800	+70	+ 3.9	1780	
24.0	2010	12	1950	−60	− 3.1	1935	
Averages				±14.7	± 4.2		

TABLE II.—ELECTROSTATIC GRADIENTS AND SPECIFIC ELECTRIC RESISTANCE.

MATERIAL.	Electrostatic Gradient at 0 Kilovolts, in Kilovolts per Centimetre.	Electrostatic Gradient at 5 Kilovolts, in Kilovolts per Centimetre.	Electrostatic Gradient at 25 Kilovolts, in Kilovolts per Centimetre.	Specific Electric Resistance in Millions of Megohm-Centimetres.	REMARKS
Air	139	16.7	11.9	∞	
Mica	4170	3200	1660	84	
Vulcanized Fibre, red	130	52	15.3	1.2 ?	Slightly damp.
Dry Wood Fibre		130		1.2 ?	
Paraffined Paper		339		34,000	
Melted Paraffin		81			65° C.
Boiled Linseed Oil		80			21° C.
Turpentine Oil		64			
Copal Varnish		30			
Crude Lubricating Oil (Mineral Oil)		16			Very impure.
Vulcabeston		36			
Asbestos Paper		43			
Creeping Discharge		10.1	.86		

As seen from these values, the disruptive strength of materials shows no relation to their electric resistance. Mica with its comparatively low electric resistance ranging highest in disruptive strength, while air combines an almost infinite resistance with only a small disruptive strength.

A table of the electrostatic gradients, at different potentials, and of electric resistances, is given in Table II.

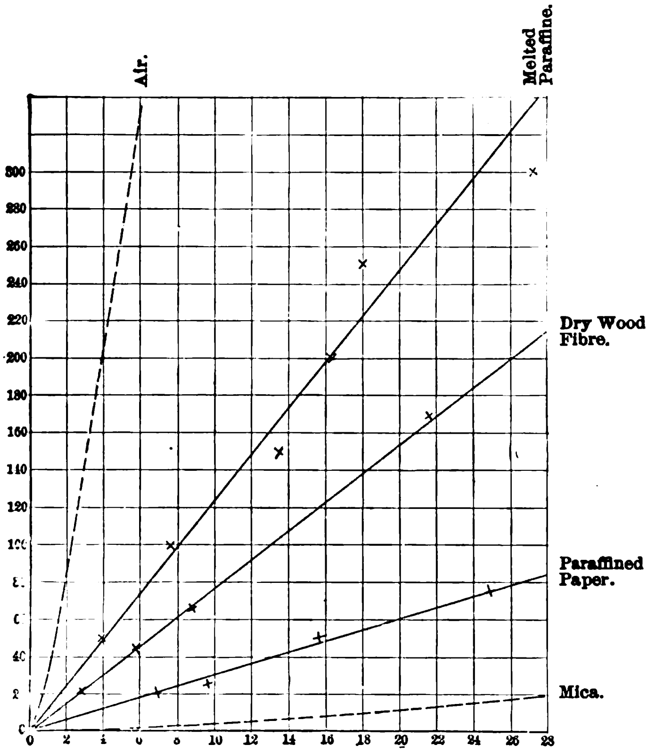


FIG. 8.

As a curiosity, it may be remarked that by extrapolating the sparking distance by means of the empirical formula of Table I,

$$\delta = 36 \left(e^{-1.3 V} - 1 \right) + 54 V + 1.2 V,^{2}$$

we would get for 100,000 volts, a sparking distance of about seven inches; for a quarter-million volts, a sparking distance of three feet; for one million volts, 40 feet sparking distance; while a lightning stroke of one mile in length would require 11,000,000 volts.

STREET CAR ADVERTISEMENTS.

A SPECIAL dispatch from Columbus, O., of March 27, says:—A committee of the American Publishers' Association has decided to bring a test case in the courts of this county for the purpose of securing a ruling on the subject of street-car advertising. At a meeting of the association in Brooklyn last February, it was determined to follow up the victory obtained in the Brooklyn courts, and Ohio was decided upon as one of the states within which suits were to be brought.

It was thought best then to bring suits in Cincinnati and Cleveland, but an event occurred in this city on the occasion of the committee's meeting which changed their purpose. The Columbus Consolidated Street Railway Company treated the citizens last Friday to the remarkable spectacle of a flat car loaded with coal and placarded with advertisements of the quality of the mineral, which was pushed back and forth over the business streets.

It is the contention of the committee that this is a flagrant violation of the purpose for which the corporation was formed, and that it has no right to carry freight over a road built to carry passengers. Columbus street cars are frequently rented by circus men and other people and completely covered with flaming posters, no passengers being allowed inside the cars.

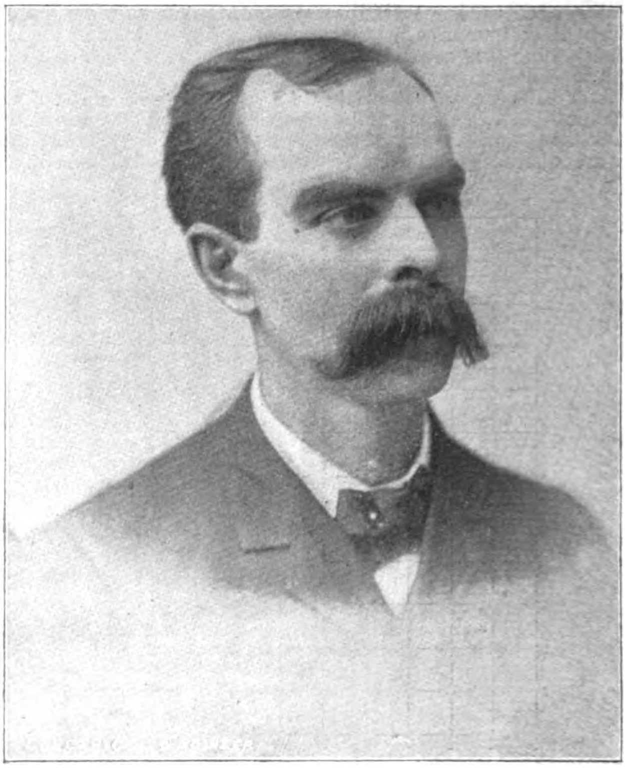
OFFICERS OF THE BRUSH ELECTRIC CO.

THE following is the list of officers of the Brush Electric Company, elected at the annual meeting of the company held Tuesday, March 21, 1893: W. H. Lawrence, president, John S. Bartlett, first vice-president, C. A. Coffin, second vice-president, S. M. Hamill, secretary, W. B. Bolton, general counsel, B. F. Miles, treasurer, S. M. Hamill, general manager, A. H. Hough, assistant treasurer, L. B. LeVake, assistant secretary, J. F. Hughes, auditor.

PERSONAL.

JOHN C. HENRY.

MR. JOHN C. HENRY, well known as one of the pioneers in electric railway work, and to whom we are indebted for a most valuable contribution in this issue of THE ELECTRICAL ENGINEER, was born at Woodstock, Ontario, Canada, in 1848. He became connected with telegraphy when very young, serving first as a messenger in the Montreal telegraph office. At that place he learned to operate in his leisure hours. In 1864 he secured a position as operator on the Buffalo & Lake Huron Railroad, and afterwards on the Great Western Railroad. In 1867 he was employed as train dispatcher of the Philadelphia & Erie Railway. This engagement was followed by a similar one on the Hannibal & St. Joseph Railroad. During all these years he had devoted himself to the study of electricity in its broad applications, and in 1869 entered the service of the Union Pacific Railway Company of the Eastern Division as electrician. This position gave him the immediate supervision of its lines and operators.



JOHN C. HENRY.

His connection with the Union Pacific Company lasted nearly ten years, during which time he may be said to have worked in nearly every department of the road that could give any play to his abilities. Throughout this period his chief diversion was the invention of mechanism relating to railroad work, and one of his inventions dating back to this time is Henry's Velocimeter, well known in technical railway circles, and used on a number of Western roads. Slightly modified by Mr. Boyer, who was a skilled mechanic in Mr. Henry's employ, the instrument is now widely popular as Boyer's Speed Recorder.

The subject which more than any other interested Mr. Henry, however, was the application of electricity to railways for motive power purposes, and being familiar with electricity he was satisfied that an electric motor could do much of the work better and cheaper than a steam locomotive. He was not satisfied until he had put his ideas in practical shape. In 1884 and 1885, being a resident of Kansas City, he constructed an overhead wire electrical railroad there. This is believed to be the first of the kind ever constructed in any country, and to be the practical germ of the trolley system as we have it to-day. Sometime in 1885 this road was inspected with much interest by the late Chas. Van Depoele, who had been devoting his energies also to railroad work, and who found much stimulus and suggestion in the pioneer work that Mr. Henry was doing. In view of the success which he had attained with his road in the suburbs of Kansas City, Mr. Henry next turned his attention to heavy electrical railway work, and in the fall of 1885 he fitted up a line on a branch of the Fort Scott Steam Railroad, where nothing would satisfy him but running street cars at high steam railroad speeds, and the hauling around of the heaviest freight cars he could get hold of.

It was natural that these experiments and developments should arrest the attention of capitalists, and hence we find Mr. Henry in 1886 equipping the Kansas City Fifth Street Railroad with his street railway system. In 1887 being desirous of change, and hearing much of the opportunities in California, Mr. Henry removed to San Diego, where he again carried many of his ideas into practical form, and operated a number of electric roads. As in Kansas City the cars were equipped with single motors weighing about 2,000 pounds, and they were frequently required at San Diego to haul passengers up a 9 per cent. grade, a task they accomplished very successfully. Another important and very desirable feature embodied by Mr. Henry in his work, was the designing of the gearing in such a manner as to allow the armature to run constantly. Mr. Henry's work in Kansas City and California constitutes one of the most important chapters of pioneer electrical railroad work, and too much credit cannot be given him for his courage and persistence, for the perseverance with which he attacked successive obstacles, and for the ingenuity with which he devised methods and mechanism to accomplish the desired result.

In 1889 Mr. Henry removed to New York, which had become at that time the great centre of electric railroad interests, and where he has since been engaged not only in electric railroad invention and improvements, but as an expert for some of the largest electric corporations. Mr. Henry's claims as *the* inventor of the practical trolley system, and as one of the most original of the early electric railway workers in this country, are now being sifted in the United States Court in a suit which is being defended by the Edison General Electric Co. He has been and remains prolific of ingenious ideas, and expects to see many of them adopted later on with the result that some of the methods now in vogue will be abandoned because he offers some better in their place. Mr. Henry takes high rank amongst men of the Edison, Field and Delany class, who, as graduates of the key, have kept step with the onward march of electric invention and industry, and have utilized the invaluable knowledge of circuits and mechanism that can only come from long practical acquaintance with them. He had also the advantage of studying railroad work closely for several years, and he aims to do as much for the poor pounded steam rail as he has already done for the inoffensive car horse.

Mr. Henry is of pleasing address, shrewd and observant, an excellent conversationalist, and of strong convictions strikingly in contrast with his shy and even diffident manner. For several years the battle of life went hard with him, but it is satisfactory to record that he is now settled with his family in one of the most beautiful of the old mansions at the pretty little suburb of Westfield, N. J.

MR. W. E. LINDSAY has been promoted from the position of chief electrician for Swift & Co. at the Union Stock Yards to that of chief engineer for the same large concern at their new plant at the National Stock Yards, East St. Louis. He will have full charge of both the mechanical and the electrical equipments, which promise to assume immense proportions. He will be succeeded at Chicago by his assistant Mr. J. Fred Galletly.

MR. JOHN A. CABOT has been appointed city electrician of Cincinnati, *vice* Mr. Robb Mackie, who has resigned in order to accept a position with the C. & C. Electric Motor Co. Mr. Cabot has been connected with the Cincinnati Edison Co. as electrician.

MR. SARGENT'S WORK FOR THE WORLD'S FAIR.

WE have been furnished, in response to our request, with the following brief but eloquent letter from Mr. D. H. Burnham, on Mr. F. Sargent's work at the Fair:—

MARCH 11th, 1893.

TO WHOM IT MAY CONCERN:—

This is to certify that Mr. Frederick Sargent has been for two years the Mechanical and Electrical Engineer-in-Chief of the World's Columbian Exposition; that the plant which has been under his charge will contain among other things:—

25,000 h. p. of steam boilers.
80,000 h. p. of engines.
4,500 arc lamps.
90,000 incandescent lamps.
3,000 h. p. to be transmitted by wire.

This plant is now far advanced in design and in execution.

Mr. Sargent has shown uncommon ability as a designer, and in management of collecting and erecting various parts of the plant. He has been upright and industrious, and very attentive to his duties. He resigned of his own motive entirely, and in spite of my request to stay, for reasons which have nothing to do with the engineering, but which to him were deemed important as affecting his authority in the work.

Very truly yours,
(Signed,) D. H. BURNHAM.
Director of Works.

Mr. Sargent could wish no better testimonial than this to his ability and integrity.

LEGAL NOTES.

THE EDISON "FEEDER AND MAIN" PATENT SUSTAINED.

ON March 28, an oral decision was rendered by Judge Green, of the United States Circuit Court, at Trenton, N. J., sustaining the validity of the Edison "Feeder and Main" patent.

The specification of this patent points out that a feeder system is one comprising two distinct parts, each of which has an independent function. The consumption circuit or "main," is the one to which the lamps are connected, and is so calculated that the greatest "drop" in pressure is negligible so far as its effect on the candle-power of the lamps is concerned. The "feeder," on the contrary, which connects the "main" with the generator has no lamps on it and the drop in pressure at its ends does not affect the relative candle-power of the lamps.

Suit was brought by the Edison Electric Light Company against Westinghouse, Church, Kerr & Co., who had installed a lighting plant at Trenton, N. J., on the alleged infringements of the claims of the patent, No. 264,642, Sept. 19, 1882, Electric Distribution and Translation System.

The following are the claims of the patent:

1. A consumption-circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle-power of the lamps connected therewith, in combination with feeding-conductors connecting the consumption-circuit with the source of electrical energy, and having no translating devices connected therewith, the drop in tension upon such feeding-conductors not affecting the relative candle-power of the lamps of the consumption-circuit, substantially as set forth.

2. A consumption circuit in the main conductors of which there is a definite small drop in tension not sufficient to vary practically the candle-power of the lamps connected therewith, in combination with feeding-conductors connecting the consumption-circuit with the source of electrical energy, and having no translating devices connected therewith, the loss upon such feeding conductors being greater than upon the main conductors of the consumption-circuit, substantially as set forth.

3. The combination of a consumption-circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle power of the lamps connected therewith, with a feeding-circuit having no translating devices, and extending from the source of electrical energy to the center of the consumption-circuit, substantially as set forth.

4. The combination of two or more central stations having feeding-conductors, and consumption-circuits supplied by such feeding-conductors, as described, of connections between the conductors of the central stations, substantially as and for the purposes set forth.

5. The combination, in one system, of a main circuit connected directly to a source of energy, and containing translating devices, and provided with resistances for lessening the tension or pressure of the current to that of the average of the system, a circuit not directly connected to the source of energy containing translating devices, and a feeding-circuit connecting the latter circuit with the source of energy, substantially as set forth.

6. The combination of a number of uninsulated wires of different lengths grouped together and fastened at intervals, forming a gradually tapering conductor, substantially as set forth.

The taking of testimony was begun in 1887, and in May of last year argument was heard before Judge Green, at Trenton. Besides an enormous mass of expert testimony submitted on both sides, numerous models were introduced to illustrate the arguments, including a miniature working central station. These were fully illustrated and described in THE ELECTRICAL ENGINEER of May 18, 1892.

The opinion of Judge Green was delivered orally, and will be filed shortly. Mr. Frederic H. Betts appeared for the complainants, and Mr. Leonard E. Curtis for the defendants.

AN AMERICAN PATENT DECLARED VOID AB INITIO.

ON Monday, March 27, a ruling was made by the United States Supreme Court in the case of Henry Huber and others against the N. O. Nelson Manufacturing Company, appealed from the Circuit Court for the Eastern District of Missouri.

The opinion was delivered by Justice Blatchford. A patent for an "improvement in water closets" was issued April 7, 1874, in Great Britain to the patentee, who assigned to James E. Boyle. The patent was to run for 14 years, with a proviso that if a stamp duty of £100 was not paid within seven years of date of issue, the patent would, at the expiration of that term, become void. Application for a patent in the United States under the assignment was made Nov. 29, 1881, and the patent granted June 27, 1882. Boyle then assigned to Huber. The £100 stamp duty was not paid in Great Britain within the time required, and the patent there became void April 7, 1881. Under these facts the Circuit Court held that the patent granted in the United States was void because it was granted after the British patent had ceased to exist, and judgment to this effect in favor of the defendants was affirmed.

Justice Blatchford called attention to a decision of the Supreme Court, March 24, 1890, in which it was held that a United States patent ran for the term for which the prior foreign patent was granted, without reference to whether the latter patent became lapsed or forfeited after the grant of the United States patent by reason of the failure of the patentee to comply with the requirements of the foreign patent law. "But that case," said the Justice, "did not distinctly cover the present one, because in that case the foreign patent was in force when the United States patent was granted."

THE FIRST TELEPHONE "INFRINGEMENT" CASE.

THE first case of objection being made to the use of "infringing" telephones which has come to our notice took place in Philadelphia last week. The firm of Kohn, Adler & Co., of that city, had installed a private line from one floor to another, using a carbon transmitter of the Clay type. They were called upon by a person who claimed to represent the Bell Telephone Company and were told that they were infringing the Berliner patent and that they would have to discontinue the use of the transmitter, or pay a royalty, or stand suit; the firm told the representative that they were willing to stand suit and that they should go ahead and use the apparatus. Upon further inquiry, Dr. Plush, president of the local telephone company in Philadelphia, stated that he had no inspector in Philadelphia and he knew nothing about the person who had called upon this firm and that whoever he was he must have had his authority from Boston. On the other hand, in looking to the American Bell Telephone Company at Boston for information, the firm was informed that everything in Philadelphia was in Dr. Plush's territory and that the parent company had nothing to do with it. Kohn, Adler & Co. then adressed a letter to the American Bell Telephone Company, reciting the facts of the case and stating that if the transmitter they were using infringed they would like to know what patent it infringed and how; to this letter they have as yet received no response. It is regarded in Philadelphia as significant that no objection was made to the use of ordinary telephone receivers on this private line—the transmitter being the only apparatus in dispute.

In the mean time, the Philadelphia Trades League has taken up the subject and has addressed the following letter to the U. S. Attorney-General :—

March 27, 1893.

The Honorable RICHARD OLNEY,
Attorney-General of the United States,
Washington, D. C.

Dear Sir:

The Trades League of Philadelphia, an organization of some 2,100 of the largest business firms of the city and which is actively engaged in an effort to decrease the exorbitant telephone charges imposed upon the subscribers in Philadelphia, and which movement is endorsed and supported by nearly every business organization in this city, would respectfully suggest that you would be warmly commended from one end of the United States to the other by the business men who have to use this, at present, high-priced business accessory—the telephone—if you would press with all diligence the suit commenced by your predecessor, Attorney-General Miller, in the Circuit Court at Boston, Mass., February 8, to annul the so-called Berliner patent, which was applied for June 4, 1877, by Emile Berliner and issued to the American Bell Telephone Company, as assignee of Emile Berliner on November 17, 1891, under which patent the American Bell Telephone Company claim the right to protection for 14 years more to come. As this matter is one of grave importance and in which we feel a deep interest, we will very much appreciate and early reply.

Respectfully yours,
THOS. MARTINDALE, *Chairman*,
ROBERT N. MCWADE,
MAHLON N. KLINE,
CHAS. W. SCHWARTZ,
A. G. ELLIOTT,
Of the Trades League Committee on Telephones.

It may be added that Mr. T. Martindale, chairman of the committee, is a leading merchant of the city and takes a lively personal interest in the fight.

THE GOVERNMENT SUIT TO ANNUL THE BERLINER PATENT.

ON Monday The American Bell Telephone Company, applied for a three weeks' extension in the suit brought by the Government to annul the Berliner patent. Judge Colt being sick the motion was not argued.

SOCIETY AND CLUB NOTES.

HISTORICAL EXHIBITS AT THE OFFICIAL HEADQUARTERS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS AT THE WORLD'S FAIR.

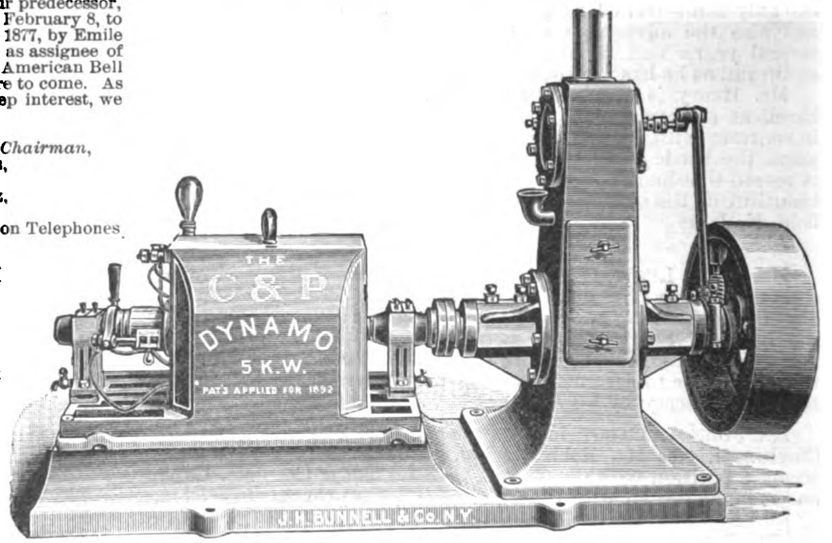
WE have received the following letter :—

At the last meeting of the Council of the American Institute of Electrical Engineers, the Committee on Ways and Means, who have charge of matters pertaining to the official headquarters of that body at the World's Fair, presented a report, and the Committee was instructed to insert a notice in the technical papers calling attention to the fact that the Institute had secured through the co-operation of the authorities of the World's Fair, two rooms adjoining the offices of the Electrical Department in the Electricity Building. These headquarters are now being furnished, and the Secretary of the Institute, Mr. Ralph W. Pope, will be in general charge of the headquarters during the exhibition, and the Committee, on behalf of the Council, wish to extend an invitation, not only to the members of the American Institute of Electrical Engineers, but to any and all of our foreign friends of the electrical profession who may visit our shores during the coming World's Fair, to use these rooms as their headquarters. Letters may be addressed in the care of the Secretary at the headquarters, and in the furnishing of the rooms, facilities will be given for writing letters, meeting friends, reading technical papers which will be placed on file, leaving their parcels and securing general information upon the Electrical Congress and other meetings, and World's Fair matters generally. The rooms will be equipped with a long-distance telephone and telegraph service, fire protection and the authorities have promised to place one or more members of the Columbian guard at the headquarters. The Institute has decided to place in these rooms various objects of great scientific and historical interest, such as photographs, pictures, autograph letters, rare electrical books, medals, instruments, etc. These things will be properly classified and arranged, and the Committee requests that all parties having objects which would prove of interest in value in this connection to communicate with the Secretary, Mr. Pope, at the headquarters of the Institute, No. 12 West 31st street, New York City, or with the Chairman of the Committee, Mr. William J. Hammer, 527 Temple Court, New York City. As we are somewhat limited for space, the Committee will be compelled to select only objects which are not too bulky, and which are of great interest and value, and they propose to make the headquarters of the Institute one of the most interesting features of the Electrical Department of the World's Fair. As the time is very limited, the Committee trust that a prompt response will be given to this call, and that all the members of the Institute will feel a personal interest in seeing that the exhibit made shall be as full and as valuable as possible. The Secretary was instructed by the Council at the last meeting to extend an official invitation to the foreign electrical societies to avail themselves of the privileges of the Institute.

Committee, { WM. J. HAMMER,
FRANCIS R. UPTON,
W. A. KREIDLER.

THE EASTON DIRECT CONNECTED BI-POLAR DYNAMOS.

WHERE space is very scant and valuable, as on board ship and in many isolated plants in buildings, it is desirable to bring the room occupied by dynamo and engine within the smallest possible compass. Evidently the most favorable arrangement to secure this end is to connect both directly without the use of belting or countershafting. To carry out this arrangement with existing types of engine and bi-polar machines requires that the latter should be specially well designed to obtain the desired E. M. F. at low speeds. With this in view the Easton Electric Company have brought out a series of machines ranging from 100 to 1,000 lights capacity, designed to run at speeds from 275 revolutions upwards.



EASTON DIRECT CONNECTED BI-POLAR DYNAMO.

The accompanying engraving shows the direct connected plant put in the yacht of Mr. Dimon, of San Francisco. The machine is of 5 kilowatt capacity, and runs at 275 revolutions. It is capable of feeding 80 16-c. p. incandescent lamps and in the present instance is also employed for running a number of arc lamps, including a small search light. This plant was placed by Messrs. J. H. Bunnell & Co., No. 76 Cortlandt street, New York, the general agents for the Easton dynamos.

MR. C. A. BALDWIN, president of the Massachusetts Chemical Co., was in Chicago two or three days last week in consultation with their Western sales agent, Mr. Harry Bishop.

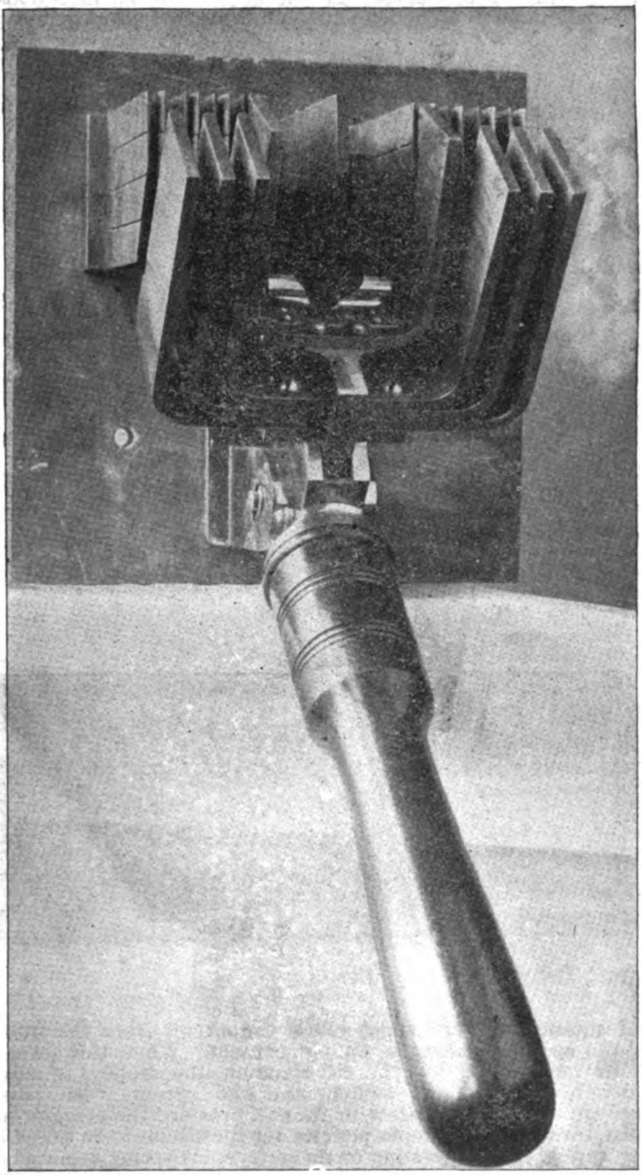
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

A 2000-H. P. AJAX SWITCH.

BY C. S. VAN NUIS.

"The unlooked for" often occurs in the best regulated electric railway plants; and, with this experience as a guide, the most thoughtful engineers equip the stations entrusted to their care with apparatus best calculated to meet all conceivable emergencies.



2000-H. P. Ajax Switch.

If normal conditions always existed in our power-houses, the designing of switch-boards would be simply a matter of a few measuring instruments, and knife-switches of simple design, with suitable bus bar connections for each particular case; but the ideal power plant, with its never varying potential and gradual changes of load, is never realized in the electric street railway field. On the contrary, a most extraordinary combination of circumstances sometimes unites to "make things hum" in the power house, and it requires the best available apparatus to insure uninterrupted service without injury to the generators. Thermal cut-outs and mechanical circuit breakers are necessary adjuncts to a power house outfit, but there are times and circumstances when these automatic safety devices do not fully meet the exigencies of the case, and a reliable snap switch is required. Electrical engineers have not been slow to recognize the advantages of a triple combination of fuses, automatic circuit breakers and the station snap switch, and instances are rare, among power plants of recent design, where this combination does not obtain.

A good illustration of the highest type of switchboard construction, up to date, is that designed by the Detroit Electrical Works, for the Calumet Electric Street Railway Company, of Chicago. The electrical equipment of this power station, which is intended to be as complete as the latest improvements in electrical apparatus can make it, will consist of ten 100-kilowatt multipolar generators, of the Detroit Electrical Works' standard type, and a switchboard for ten generators and eight feeders. The switchboard will be of white marble and each generator will have a separate section equipped with the Detroit Electrical Works' ammeter and limit switch, Ajax triple-pole switch and duplicate fuses, and also a bus switch and hand regulator. Each feeder will have a separate section, equipped with an ammeter, a limit and bus switch, of the same type as those for the generators, a single pole double break Ajax switch with duplicate fuses and a Wason station lightning arrester.

In the centre of this board will be a main section, upon which will be mounted one 3000-ampere meter, a potential switch for connecting any generator to voltmeter, and one 3000-ampere single pole double-break Ajax switch. This is the largest in capacity of any snap switch ever manufactured, and is illustrated in the accompanying engraving. It is claimed by the designer of the Ajax switch that this one will successfully open a circuit carrying its full rated capacity at a potential of 500 volts, which is equivalent to 2,000 electrical horse-power. The space occupied by this "little giant" is but 9½ × 10 inches.

THE WORLD'S FAIR.

GENERAL ELECTRIC EXHIBIT.

The space reserved for the General Electric Company's exhibit in the Electrical Building, says the Lynn, Mass., *Item*, is the finest and most desirable location in the entire building. It consists of the entire open centre of the main floor, and the surrounding spaces under the galleries. Persons entering the building from any side will at once pass into this exhibit, and during the entire stay in the home of electricity at the fair will have the exhibit continually in view.

When it was decided to make an elaborate exhibit it was deemed advisable to subdivide it into departments, and as a result one will find all of the modern railway apparatus under the head of the railway department. The meters will appear in the special meter department. Apparatus for isolated plants in the isolated department, etc. There will be a complete line of arc lighting machines from the smallest size to the largest, all in actual operation, and equipped with switchboards, lamps and everything complete. These machines will be run by electric motors, as steam engines will not be allowed in the Electricity Building. The motors will be fed from the generators in Machinery Hall.

A complete line of stationary motors will be exhibited in the motor department from the small one-twelfth horse-power machines to the largest sizes, and there, too, will be found many of the latest adaptations of this most useful labor-saving device. In the mining department will be exhibited immense pumps, hoists, drills, coal cutters and mining locomotives, all calculated to show to what a vast extent it is possible to utilize electricity in mining operations.

In the central station department direct-coupled machines for both continuous and alternating currents, with the latest appliances for both street and station use, will be placed on exhibition. The company is also engaged in installing a large proportion of the power plant at the fair, and this, together with the immense lighting plant in Machinery Hall, will be calculated to demonstrate to the visitors at the fair what has been done in the electrical line in the past few years. To the people of Lynn this will be doubly interesting and a source of pride.

ACTIVITY OF THE DETROIT ELECTRICAL WORKS.

Recent sales reported by Mr. L. E. Myers, manager of the Chicago office of the Detroit Electrical Works are three 100-kilowatt generators and six 30-h. p. single reduction motors to the Belle City Street Railway Company, of Racine, Wis.; also two 100-kilowatt multipolar generators and nine 30-h. p. single reduction motors to the Fox River Railway Company, of Green Bay, Wis. The Detroit company has about completed for the Calumet Electric Railway Company, of Chicago, a magnificent white marble switchboard. The board is some 36½ feet long. The instrument cases are made of highly polished burnished copper, and are extremely handsome in design and workmanship. The marble sections comprising the board are all set in polished brass frames. These and many other points make this one of the very finest switch boards in the country. It is to be installed together with 10 of the Detroit Electrical Works' multipolar generators.

THE "C. C.-H CO." ELECTRIC HEATER.

In the construction of the electric heater made by the Consolidated Car-Heating Company, of Albany, N. Y., the resisting conductor is divided into a number of parts so that these parts may be assembled in different combinations, offering different resistances to the passage of the current, so as to obtain different intensities of heat. For convenience, the resisting conductor on each car is divided into 12 equal parts, two of these parts being combined into one heater so that six heaters are placed in each car, three on each side. The resisting conductor wire is coiled in the form of a close and continuous helix. A cylindrical glazed porcelain insulator is provided mounted upon a five-eighths inch square iron rod. A helical groove is formed upon the surface of this insulator and extends continuously from one end of the heater to the other.

The resisting conductor is placed in the grooves after being drawn out sufficiently to prevent neighboring coils from coming in contact with each other. At the end of each division of the heater a glazed porcelain plate is provided in which binding screws are placed, to which the ends of the resistance coil are connected. The two parts of the resisting conductor placed in each double heater are separated by a glazed porcelain plate, so that the parts may be connected independently where the plan of wiring so requires. The arrangement is clearly shown in Fig. 1.

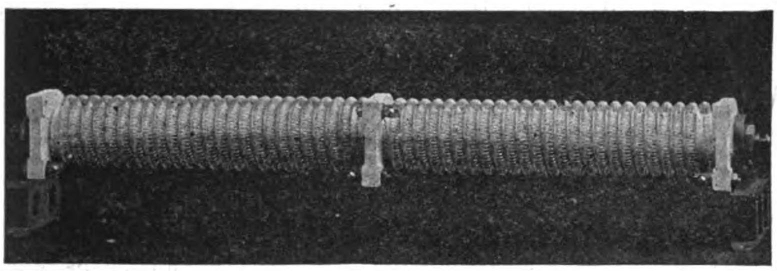


FIG. 1.

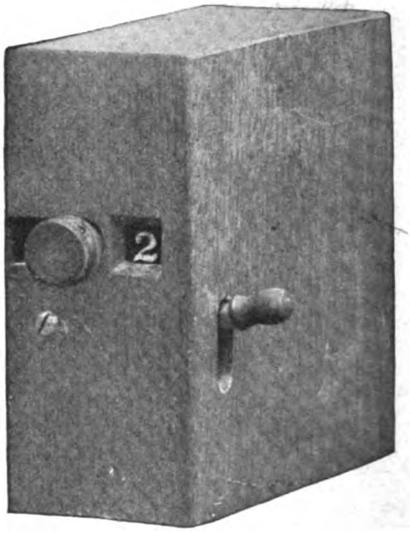


FIG. 3.

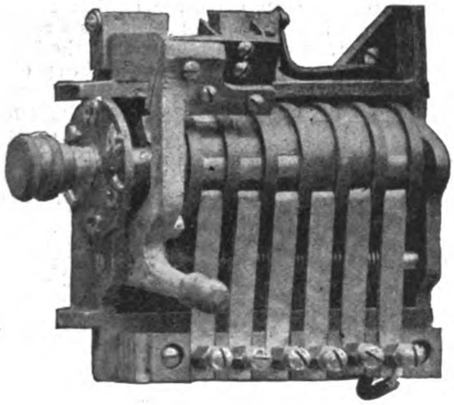


FIG. 4.

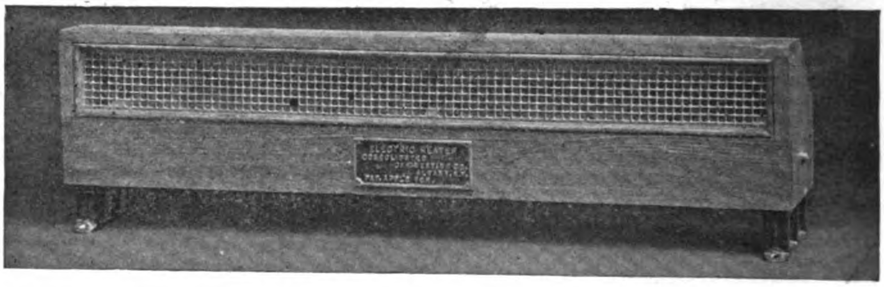


FIG. 2.

THE "C. C.-H. CO." ELECTRIC HEATER.

The heater is covered with a wooden box, shown in Fig. 2, which is lined throughout with asbestos mill board, in which is made a screened opening through which the circulation of air from the heater is maintained.

The regulating switch, Fig. 3, has six different positions, in one of which the circuit is open, while the remaining five give different intensities of heat. Different combinations of the heaters are made by the different positions of the switch, so as to increase or decrease the flow of current to correspond with the increase or decrease in the heat required.

In the first position of the switch all of the heaters are placed in series so that the current from the trolley must pass through their combined resistance. In the second position one-third of the total resistance is thrown out, the remaining two-thirds being placed in series. This results in an increase of about one-half in the intensity of heat. In the third position the switch recombines the heaters in a multiple series of two, thereby still further increasing the flow of current and obtaining a corresponding increase in the intensity of heat. In the fourth position the total heating surface is again recombined in such a way that one-third of the heaters are thrown out and the remaining two-thirds are combined in a multiple series of two. In the fifth position the remaining one-third are thrown in, making a multiple series of three.

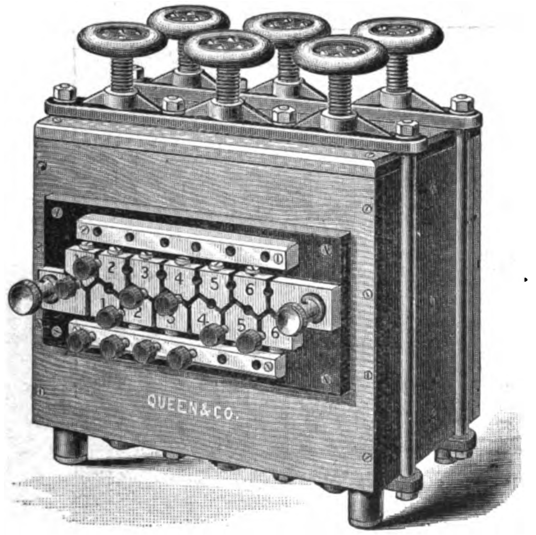
The construction of this switch is shown in the accompanying illustration, Fig. 4. It consists of a cylinder of insulating material which carries in fixed position on its circumference pieces of conducting metal. Connections of the metal contacts are made through the substance of the insulating material itself. The wires connecting the heaters in the several combinations necessary to obtain the different intensities of heat, are connected to binding posts in the switch and terminate in multiple spring contacts resting upon the surface of the cylinder carrying the contacts. A notched wheel is attached at one end of the cylinder, the notches being six in number and corresponding to the six positions of the switch. There is also provided a rock shaft carrying a lever at one end at the side of which lever is a lug fitting in the notches in such a way that when the lever is pushed forward to its normal position, the lug enters the notch and prevents rotation of the cylinder. By throwing the lever back the lug is withdrawn from the notch and the cylinder is then free to turn in either direction. This lever has attached to it an insulated arm which projects through the switch cover. At the long end of the lever above described there is attached a U-shaped piece of metal by means of insulating material which closes the circuit from the trolley to the switch, making a double contact. When this lever is in its normal position, the circuit from the trolley is closed through the auxiliary switch, and the current then passes through the electric heaters in the car, provided the cylinder has been turned to the proper position for the circuit to be closed by the spring contacts resting on its surface. A spring is placed on this rock shaft so as to throw the lever forward to its normal position. The lever is withdrawn from this position only when it is desired to change the position of the cylinder.

When it is not desired to use heat on the car, the cylinder is turned to a position where the figure O shows through the opening in the cover. When it is desired to place the switch so as to form any desired combination of heating surface, the lever is drawn down; thus opening the circuit from the trolley and releasing the cylinder, which can then be turned in either direction until the number on the dial representing the desired combination of heating surface appears through the opening in the cover. By releasing the lever it then springs back to its normal position, locking the cylinder and at the same time closing the circuit from the trolley.

It will be seen that it is impossible ever to turn the cylinder while the current is on, as the movement of the lever necessary to unlock the cylinder invariably opens the circuit from the trolley. It will also be seen that the circuit from the trolley cannot be closed unless the contacts on the cylinder are fully made.

NEW QUEEN MEASURING APPARATUS.

A REMARKABLY efficient adjustable rheostat for laboratory purposes, depending for action upon the fact that the resistance of carbon is decreased by compression, has been introduced by Queen & Co., Incor., of Philadelphia. The carbon used is in the form of rods placed flat, layer upon layer, in sections arranged for the purpose. A metal faced pressure block moving like a piston, in each section, and operated by a wheel above, makes contact with the upper layer, while a metal sheet binds against the lower. Each section is constructed to carry from 0 to 25 amperes at an E. M. F. not over 5 volts. The terminals of each section are brought to a switchboard by means of which the sections can be connected as desired. Using the sections in multiple the rheostat may be made to carry 150 amperes. Currents up to 25 per cent. above these figures may be passed through for a short while. The regulation of the resistance which is accomplished by means of the pressure blocks is a special feature of the instrument. The resistance may be varied from 0 to 150 amperes to as close a degree of accuracy as may be detected by the current indicating instrument. The change, moreover, is gradual and not by steps, as it must always be in the ordinary form of rheostat. It is therefore of especial value in calibration work and for determining the characteristic curves of dynamos and motors. The whole instrument is substantially put together and can be readily carried from place to place.



Queen & Co.'s Adjustable Rheostat.

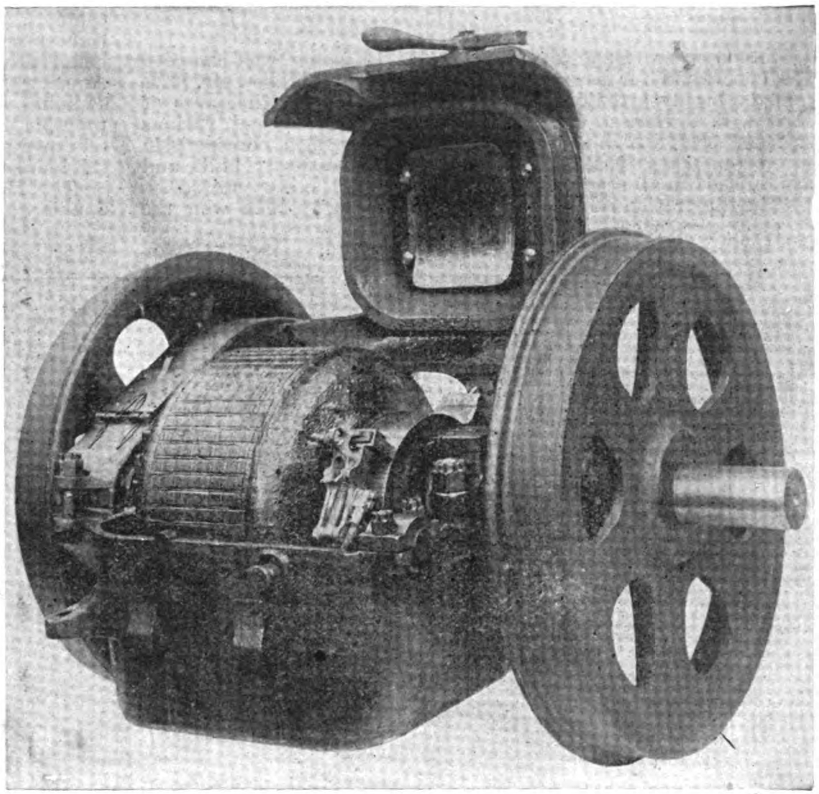
THE SHORT ELECTRIC RAILWAY CO.

THE annual meeting of the stockholders of the Short Electric Railway Co. was held at the office of the company last week. The following directors were elected: S. H. Short, W. H. Lawrence, M. T. Herrick, W. B. Bolton, B. F. Miles, James Parmelee, and S. M. Hamill. Immediately after the stockholders' meeting, the directors met and elected the following officers: B. F. Miles, president; S. H. Short, vice-president; W. B. Bolton, general counsel; S. M. Hamill, general manager. The following executive committee was elected: W. H. Lawrence, B. F. Miles, S. M. Hamill. The usual reports were presented to the stockholders.

One of the officials of the company writes us: "There have been a number of rumors that the Short Co. expects to go out of business. This is not true as far as I know at present. The Short Co., however, is brought more closely into contact with the Brush Electric Co., and the companies can thus be managed much more economically. One set of officers and one set of agents cost less than two sets of the same luxury. The Short Co. expects to push the new and modern gearless motor, a number of which we are now building in our shops, and some of which have run very successfully on the Cleveland street railways."

THE GENERAL ELECTRIC MOTOR FOR NARROW GAUGE TRACKS.

THE GENERAL ELECTRIC COMPANY has recently designed the new type of single reduction motor, shown in the accompanying illustration, designed especially for use on tramways and other places where a narrow gauge is desired. In general principle of design this motor closely resembles the standard W. P. type, with the exception that it has four poles, the two salient ones of which are top and bottom and the two consequent poles at the sides of the frame. The armature, field spools, commutator, brushes and all the trimmings of the motor are entirely enclosed by the frame, and the armature bearings are so designed as to allow only a bare clearance between the wheel of the truck and the sides of the motor. These motors are wound for either 200 or 250 volts, and are rated at about 250 pounds horizontal effort on a 20-inch wheel. The extreme outside width is only about 15¼ inches, so that the motor may be used on a road of but 18-inch gauge. The total weight of the motor with gear and gear case complete is about 680 pounds.



General Electric Co.'s Narrow Gauge Motor.

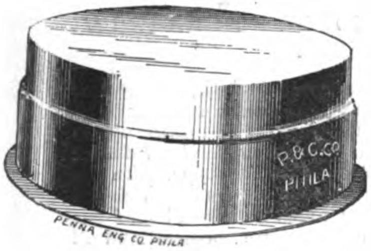
THE TESTING DEPARTMENT OF THE MASSACHUSETTS ELECTRICAL ENGINEERING COMPANY.

IN its engineering practice this company has found it essential to establish for its own service a testing department, equipped with facilities for thorough investigation of electrical materials, machines, apparatus, devices, etc., of all sorts required in electrical construction and installation. The need of such tests made by unbiased and competent authority is well recognized by purchasers and customers in every branch of electrical work, and the demand for it on their part is becoming daily more keenly appreciated by those who are putting goods upon the market. The result of this is a growing call for testing work of this class.

The value which the reports of tests by the testing department of the company possess is most strongly indicated by the increasing demand for them, coming not merely from new sources but largely from former clients. The very general use which is made of the report when the test is of a character to be of interest to the electrical fraternity also bears testimony in the same direction

THE PARTRICK & CARTER POCKET BUZZER.

The accompanying illustrations show, in its true size, a convenient little buzzer about to be introduced by the Partrick & Carter Company, of Philadelphia.



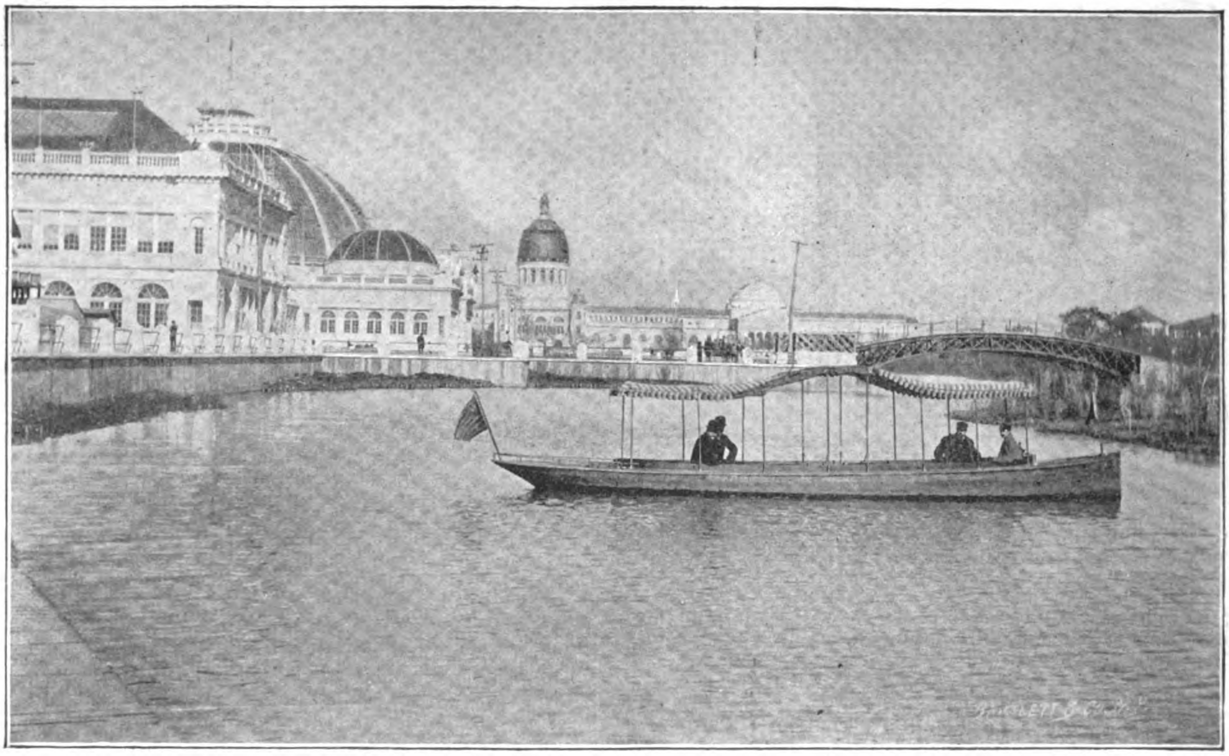
Patrick & Carter Pocket Buzzer.

The instrument is made entirely of metal nickel-plated, gives a clear, loud and pleasant sound, and will answer in many places where larger buzzers are used. It is a handy circuit tester and will be found useful by wiremen and bell-fitters.

THE GENERAL ELECTRIC LAUNCH CO.

The General Electric Launch Co., to whom was awarded the concession for passenger launches at the World's Fair, have issued a highly artistic eight page catalogue from the press of Messrs. E. E. Bartlett & Co., giving data concerning their various styles of craft which they are now turning out in considerable numbers. These boats are carefully and beautifully built, and are finished in all respects in accordance with the best practice.

The illustration shows the launch "Electra," which won the World's Fair concession for the company, as she appears on the lagoons at Jackson Park. The "Electra" was built in April, 1892, and distanced all competitors after tests of the severest kind, one of which was a ten hours' continuous run with a load of 25 persons. She is 34 feet over all, and, though her speed is restricted to six miles per hour at the Fair, she is capable of making 11 on a spurt.



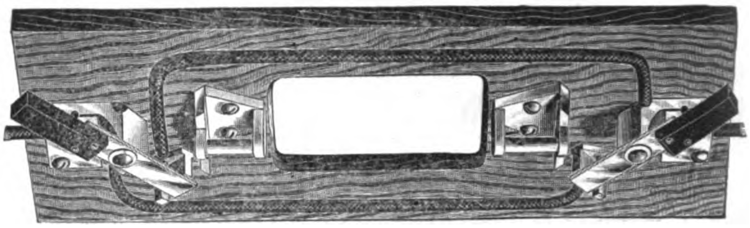
General Electric Launch Co.'s. Launch "Electra," on the Lagoon at Jackson Park, Chicago.

The company will furnish 54 launches on substantially the same lines for use during the Exposition.

The Street Railway Men find that Okonite wire is excellent for car work, as is evidenced by large demands from this trade upon the Central Electric Company, Chicago.

THE DOW HANGER BOARD FOR ARC LAMPS.

In order to meet the demand for a first-class ceiling board to be used in connection with arc lamps, Mr. Alex Dow, the well-known electrical engineer of Chicago, has designed the one shown in our cut. It has a number of novel features which will commend themselves to those who have had experience with other hanger boards. It has a central opening through which the tubes project, the lamp itself being hung on the brass supports next to this opening. The wires can be run into the binding clamps from the end, as shown in the illustration; or they may be bent at right angles and inserted transversely, so as to allow of their being drawn taut without pulling them out of the clamp. Another peculiar feature lies in the two simple but effective switches which make the board an absolute cut-out. In ordinary practice only one of these would be used, but if the lamp is to be trimmed both switches are thrown to the "off" position, leaving the lamp entirely disconnected from the circuits.



Dow Hanger Board for Arc Lamps.

The Dow hanger board is built in both the oblong form for double carbon lamps, and in round form for lamps with a single carbon. It is being put on the market by George Cutter of Chicago.

The Philadelphia Edison Company has issued notice that it is wiring up for 30,000 additional lights on its present mains.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XV. APRIL 12, 1893. No. 258.

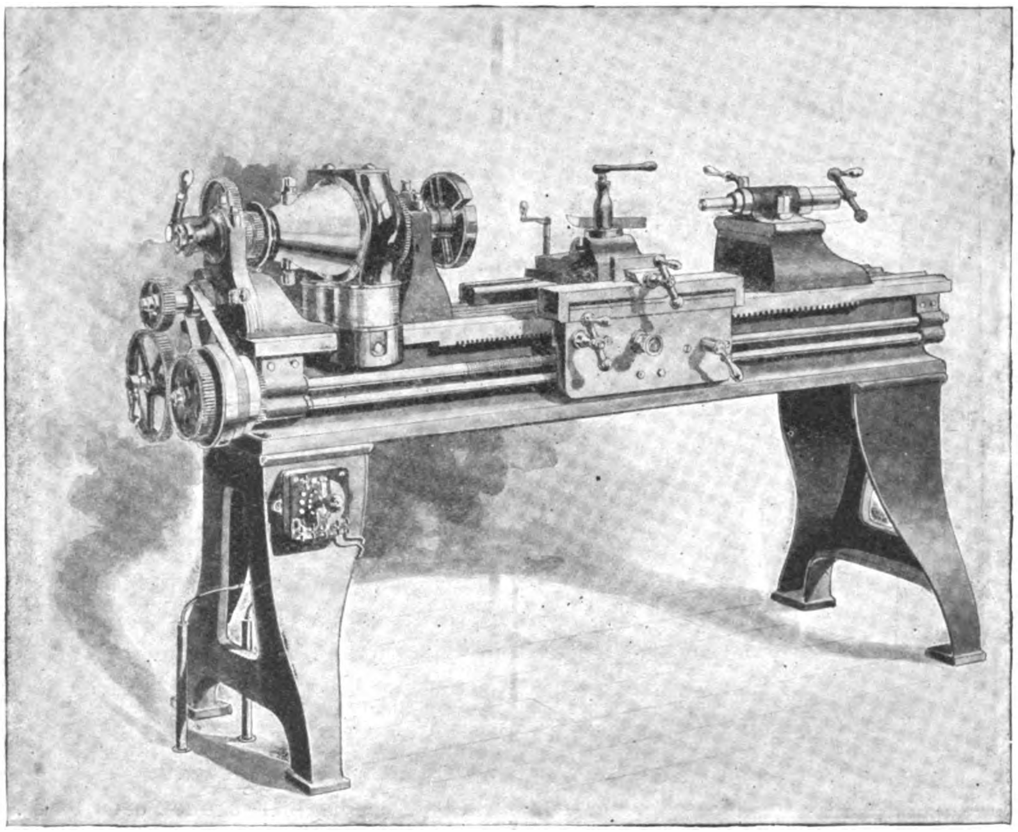
ELECTRIC MACHINE TOOLS.

BY

S. S. Wheeler.

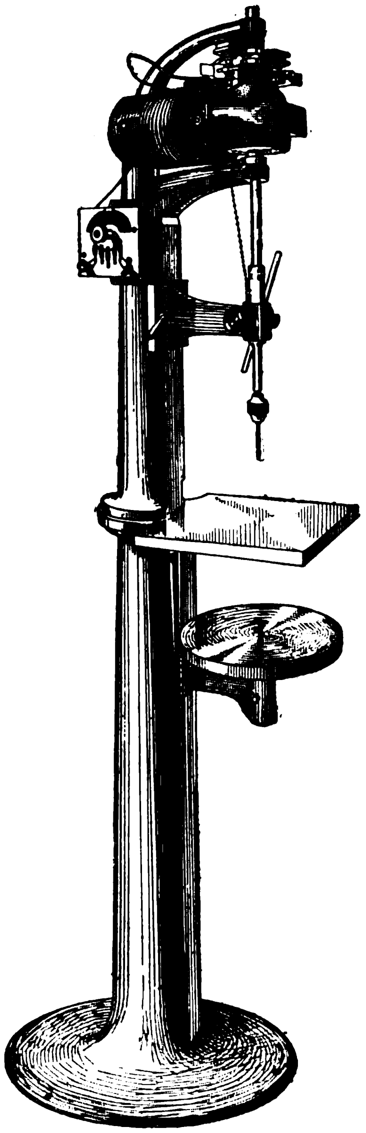
THE adoption of electricity as a means of transmitting power in modern machine shops, in place of extensive and heavy lines of shafting, has entered, it seems to me, upon one of its most important phases. We have already witnessed several interesting applications of electric power in merely drive lines of shafting; but it is none the less obvious that in a great variety of places, and under an immense range of conditions, it is better to incorporate the motor with the driven mechanism. In short, they become virtually one tool or one machine, with the result that the efficiency and economy and adaptability of the device reach their highest point.

This object has been in my thoughts for many years, in connection with the development of electric motors, and, with my associates, I have concentrated no little time and money on the many different problems of so adapting or modifying electric motors that they may be built directly into such tools as lend themselves to the purpose, in factories. but, as in the earlier stages of electric lighting, the transition exhibited was only partial. In other words, the motor has been used largely as a means of transporting the power, but not of applying it, so that while we have seen the electrical generator installed in the power-room, the motors driven by it have been utilized only to operate longer or shorter lines of shafting. This is all very well, but is a makeshift, for if there be any virtue in electric power transmission it should show itself in the direct application of the energy to the work. Of course, it is obvious that in many places, it is desirable that the motor should place of belting the motors to the countershafting here and there. Some tools invite this treatment much more than others do, and in the future I believe that the tools of newer design will owe their specific shape and construction very largely to the changes now being introduced by the use of electric power in this direct manner.



POWER LATHE DRIVEN BY ELECTRIC MOTOR IN HEAD STOCK.

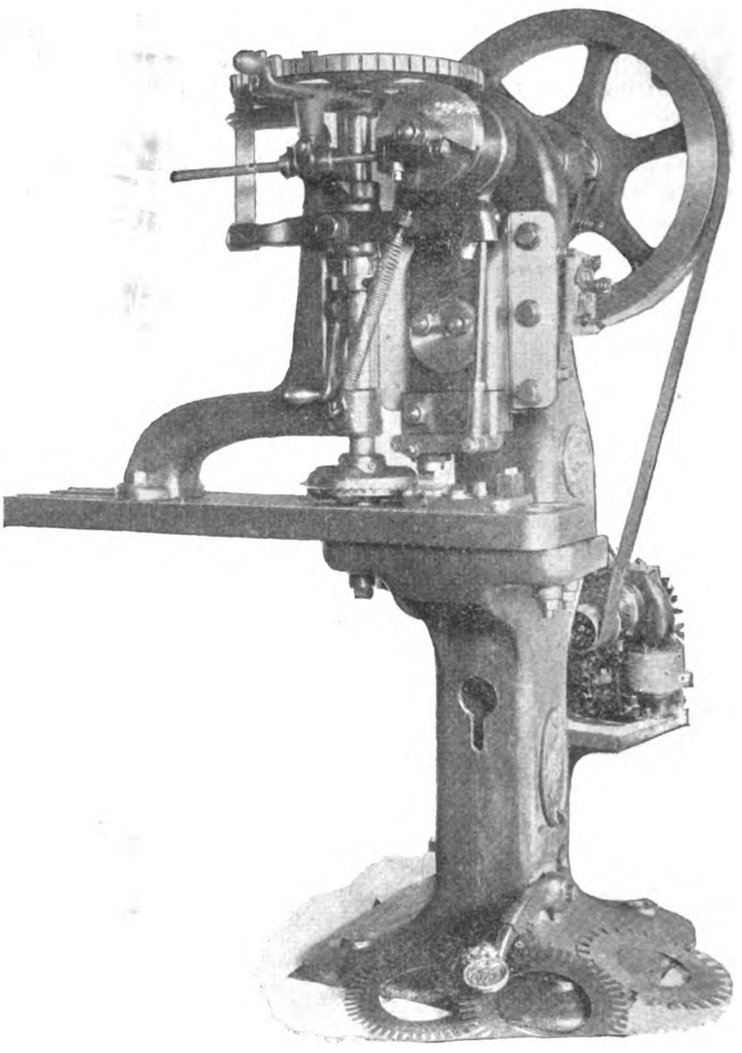
This important class of improvement is immediately suggested by the appearance of the temporary rigs, in a shop using electric power, but like many other things, it had not been given attention by most persons until the use of electricity for power had become pretty general. After adopting a line of electric bars or mains through a shop in place of the ordinary revolving shafting, and after belting a few motors to lathes and other tools and connecting them to the bars, it is easily seen that much better mechanical arrangements could be made by building in the motors as an integral part of the several tools. This construction gives rise to directly connected machine tools, a new line of machinery brought out by the Crocker-Wheeler Electric Company, and destined in my judgment, to be of very great importance. These machines are the regular standard tools of the market, but with motors combined, both being properly proportioned for their purposes, so that when the small flexible cable or lamp cord is connected to them from the power line they become operative and are self-propelling tools, readily portable if desired. Machinery of this kind obviously has a number of important advantages. It requires no setting up. It can be moved and then used so readily that it makes temporary shifting of machinery to meet requirements of extra work in one department practicable. A single tool can be run at any time without running others, thus saving all shafting friction, etc. The tool having no belts and the power being generated in the head stock just where it is consumed, the machine runs much more quietly, etc.



Electric Drill Press.

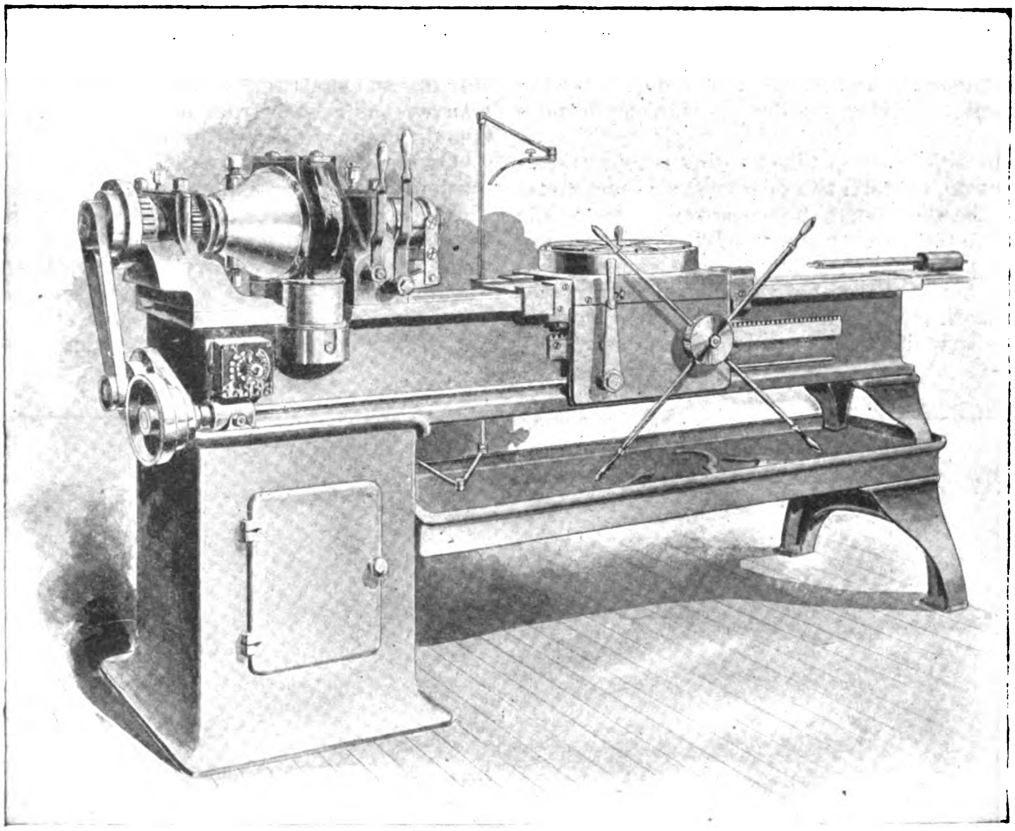
Quite a variety of direct connected machines have already been built and put in use, with such success, that we now propose and are prepared to design motors for all classes of machine tools. A brief description will, I think, be found of general interest. The electric lathes, for example, are built on this principle, the motor armature taking the place of the belt pulley, and the field magnet frame being part of the lathe bed, securing simplicity and rigidity. The tool possesses many advantages suggested by the hints above, and I recommend it for all machine shops, laboratories, etc., where electric current can be obtained. Other small tools such as monitor or screw machines, are, of course fitted up in the same way. I illustrate a large screw machine provided with its own motive power or motor, which is capable of delivering ½ h. p.

Motors have been applied to portable shapers in the manner shown in the illustration, the use of electric power rendering it possible to carry the tool to the work in cases were the work is very heavy, such as dressing armor plates when in position on vessels, trimming very heavy castings, etc. After all, it is often more natural to take the tool to the spot and use it there; and this innovation may lead to some change in factory construction. The tool is taken to the work and clamped to it by the bolt slots seen on the under side of its bed plate, and a sufficient amount of power (1 h. p.) to operate it, even with the heaviest cuts, is carried to it from the electric mains through a small flexible cable wherever it may be moved about. As may be seen from the illustration, the reversed motion of the shaper is produced in the usual way by a crossed belt, and the high motor speed is converted to the slow speed for the tools by means of a worm gear.

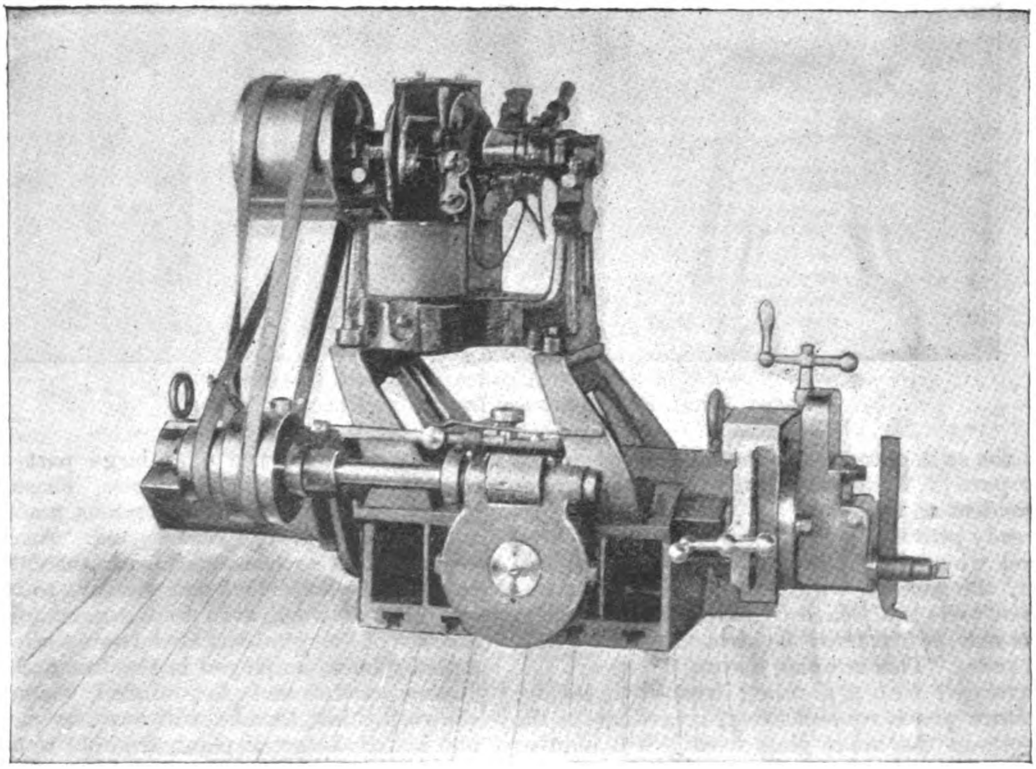


Electric Punch Press.

The electric drill press is still another application of the same idea. The spindle of the drill press becomes the shaft of the motor, and while continually revolving with the armature, may be moved downward to follow the drill when boring a hole. The operator starts and stops the machine by turning a switch attached to its side, so that current is consumed only when the drill is in actual operation. A drill press as usually set up requires two countershafts, four belts and two mule pulleys. That is really a serious array of power-wasting parts. The direct connected motor saves all this. The illustration shows a one-fourth horse-power size which easily operates a five-six-



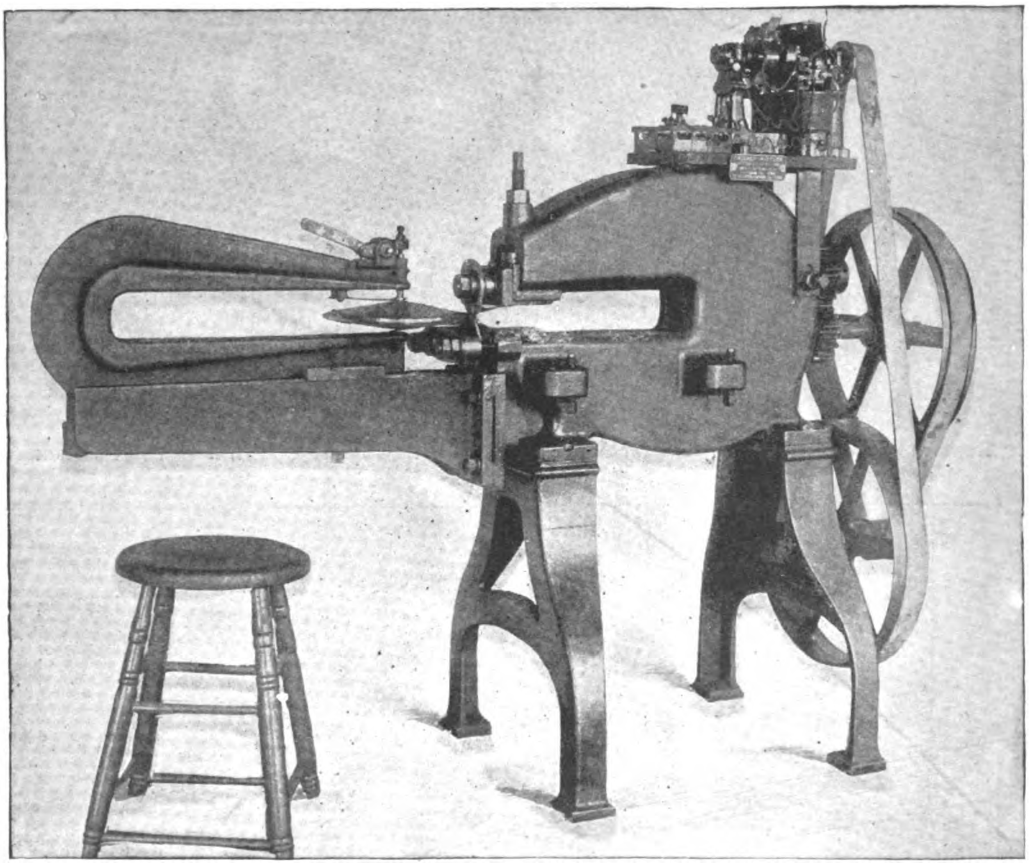
Electric Machine Tools:—Screw Machine Driven by Electric Motor in Head Stock.



Electric Machine Tools:—Portable Shaper Driven by Electric Motor.

teenth inch drill. The power absorbed by the motor when doing full work is not much more than that required for an ordinary incandescent lamp, and may be conveyed through a flexible wire not larger in diameter than an ordinary darning needle. This combination obviously can quickly be moved from one part of the shop to another and put to work immediately without the usual trouble of lining up to main and countershafts and belting, as required by the ordinary drill press. Having no belts it runs much more quietly and easily.

I am glad to be able to show also another very interesting direct application, namely, the operation of sheet metal power shears. The one-fourth horse-power motor while attached directly to the tool is geared up by belting passing over intermediate pulleys, which at the same time serve as belt-tighteners by being adjustable vertically. The power required for the work is much reduced by the directness of application. The machine can be stopped and started in an instant by the switch knob near the motor, and can be moved to any part of the shop and used at once without the troubles incident to lining up.



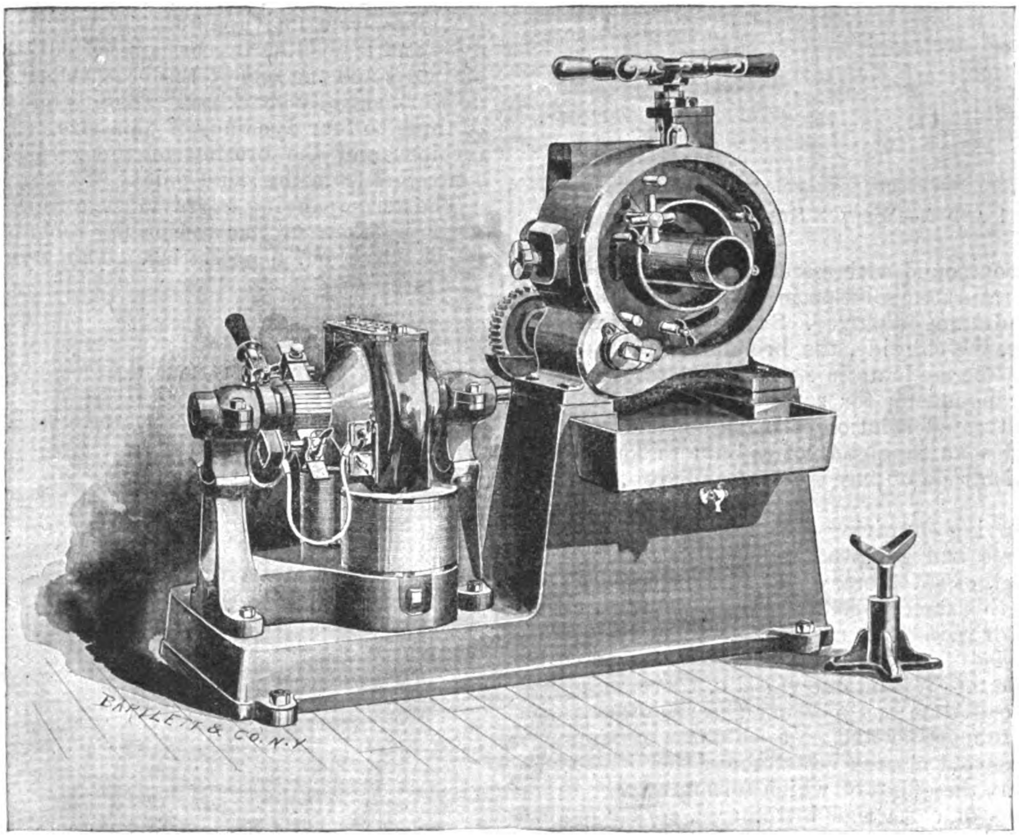
Sheet Metal Power Shears Driven by Electric Motor.

In shops already provided with a number of tools driven by belting, and where it is found desirable to introduce electric power, the motors are simply bracketed to the ordinary form of tools, and connected by means of belting. An idea of this may be had from the illustration of a $\frac{1}{2}$-h. p. electric punch press. The machine shown is a special one ingeniously arranged with a dividing head or index for notching armature plates consecutively, according to the number of teeth in the index plate used. Still another variety of application is shown in the electric pipe threading machine, which needs no special description as its operation is precisely the same as with all machines of this character. In connection with these direct driven tools it may be well for me to call attention to the absolute practical results which have already been obtained by the use of electricity in machine shops, than which no subject can be of greater interest to manufacturers.

Under the usual manufacturing conditions involving the driving of tools or machines intermittently operated, only 15 to 25 per cent. of the total power supplied by the engines is expended in useful work. It is well known that a very large portion is required simply to move the great pulleys, belting and shafting, which, starting from the engine-room, convey the power from floor to floor, and distribute it to the different wings and parts of the factory.

Owing to the heavy and cumbersome nature of the system of shafting, pulleys and belting alluded to, not only does the great expenditure of power required to move these mere carriers or conveyors of power go on constantly whether the whole factory is in operation or only the most distant part of it, but so great is the friction of the great moving mass, that no proportionate effect is felt at the cut-off of the engine by the minor and constantly occurring stoppages in the use of a large part of the individual machines, lathes, looms or tools. These single and short stoppages aggregate an enormous amount of time, and therefore of power or coal wasted. An electric system can be furnished so connected with the cut-off of the engine, so perfectly responsive and sensitive to all such changes of intermittent work, even to the most minor ones, that the amount of energy demanded from the engine is only that actually being employed in the doing of useful work.

Any candid and fair-minded manufacturer can be shown, I think, that he will save, by a properly-designed and installed electric plant, from 30 to 50 per cent. of his coal bill, besides having a system greatly superior in every respect to the old one. The manufacturers of these electrical tools have given especial study to this branch of the practical application of electricity, but are very glad to be favored with the advice and suggestions of manufacturers and factory owners, many of whom have noted instances in their own experience of opportunities thus to economize in the use of power, and, at the same time, by instant and close regulation of the power, to obtain a higher quality of product. But too frequently, it is to be feared, electric motors and power devices have been put forward whose nature renders it impossible that they should accomplish any purpose of economy or efficiency in factories and machine shops; and the only way I know of to find out what is needed, is to study the nature of the machines and tools in familiar use. This study, I venture to believe, has been very fully entered into and enjoyed by the Crocker-Wheeler Co. in its practical work of building motors and machinery for several years past. Without it, we should never have made these new departures; with it, we have been encouraged not only to build these motor-tools I have described, and others, but to employ them in our new works at Ampere, N. J. At those works, the lines of jack-shafting and counter-shafting, with belts and pulleys, have been replaced by copper bars from which current is tapped at any point, and the tool is at once available over a very large floor area. Where it would take, say, an hour or two to bring the work to the tool, with consequent interruption of other work, these tools can often be ranged alongside the work in five minutes. And whether moved or not, they still present the inherent features of economy and utility that I have been seeking to emphasize. It seems to me that what we have found so eminently suited to our purpose as builders of machinery, must be equally desirable in other large machine shops; and in that faith we have gone quietly to work to ascertain the best forms and to demonstrate the actual elements of saving and benefit involved. I shall avail myself of an early opportunity to return to this subject and point out some other very interesting and important features of this new class of work. The examples I have now given will suffice to demonstrate the peculiar handiness of such tools, and, I think, to win general approval for them.


BARTLETT & CO. N.Y.

Electric Machine Tools:—Pipe Threading Machine.

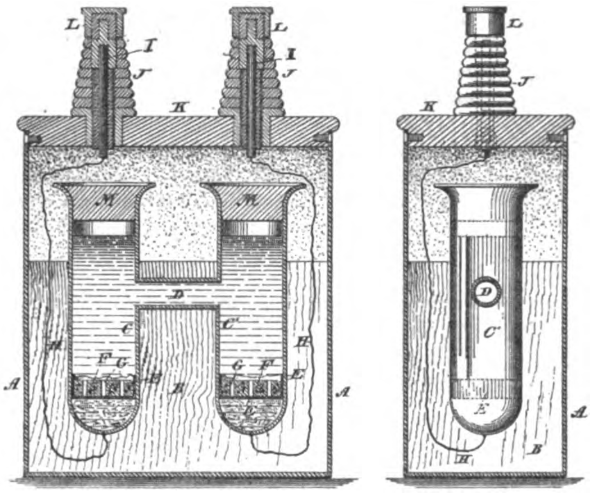
THE WESTON STANDARD CELL.

The importance of employing accurate measuring instruments in electrical work and of having accurate standards for comparison and calibration is gradually being recognized even among those who but a short time since looked upon any instrument of known precision as an unnecessary refinement and hence to be avoided as involving a useless expense. The one to whom more than perhaps any one else is due the credit of having, at least in this country, brought the electrical public at large to the realization of the value of reliable indicating instruments is Mr. Edward Weston, whose work in this and other fields we have had frequent occasion to touch upon in these columns. It cannot be too highly spoken of.

Mr. Weston's aim all along has been to devise a series of standard instruments for all classes of electrical work, and in following out this scheme his attention was early directed to the production of a primary standard of E. M. F. which should be available for the standardization of all the other instruments in the series. The standards of E. M. F. available up to the present time did not come up to the ideal which Mr. Weston had set before him, even the best of these, the Clark cell, being subject to a variation of .077 per degree centigrade.

In analyzing the causes for this Mr. Weston discerned that the density of the zinc sulphate solution is dependent upon the temperature of the solution, and with every change in density there is a corresponding change in E. M. F. Again the local action which takes place in such cells affects the E. M. F. to an appreciable extent and hence it was evident that to gain his ideal Mr. Weston was obliged to construct a cell practically without temperature error and free from local action. Such a material Mr. Weston has found in the cadmium salts.

Their value for this purpose appears to be due to the fact that such salts are equally as soluble in hot as in cold water; the density of the solution remaining substantially the same, so that there is no disturbance of E. M. F. due to changes in density. The chemical affinities in the cell are substantially the same, no matter what the temperature of the cell may be within reasonable limits ; and in fact, we have the very remarkable condition of the action of chemical affinities being practically unhelped by heat. Any salt of cadmium may be used, the acid of which forms a practically insoluble compound with mercury when the salt is in the state of a saturated solution in water, or in a solution of the salt of cadmium employed. Such salts, for example, are the sulphate, the chloride, the bromide and the iodide.



FIGS. 1 AND 2.—WESTON STANDARD CELL.

The cell may be made up in a number of ways but one of the best arrangements for an absolute standard cell is to employ a saturated solution of cadmium salt in water, and as electrodes an amalgam of cadmium and mercury opposed to an electrode of pure mercury and proto-sulphate of mercury.

The accompanying engravings, Fig. 1 and 2 show the cell in transverse and longitudinal section respectively. A is an outer shell of sheet brass and elliptical in form. In the bottom of this shell is inserted a wooden block B containing cavities or recesses to receive the glass cells C C'. These cells consist of two cylindrical vessels connected by a transverse tube D. Within one vessel C, there is placed an amalgam of cadmium and mercury ; in the other vessel a mixture of pure mercury and proto-sulphate of mercury. There is then inserted in each vessel above the electrode, a piece of muslin E, the edges of which turn upward. In the cup-shaped piece of cloth thus introduced, cork F pierced with apertures G is inserted. The arrangement of cork and muslin serves to hold the materials of the electrodes in place and prevent their becoming commingled with the solution when the cell is moved about. At the same time, the openings in the corks F allow of free contact of the solution with the electrodes. There is then placed in each cell C C', a saturated solution of cadmium suphate. Lastly, the stoppers M are secured in place with cement. The connecting wires H pass through the bottoms of the cells C C' and communicate electrically with the electrodes. They are connected to copper wires I, which are received in binding posts J. These binding posts J are carried by the cover K of the shell, which cover is made of rubber. The binding posts are provided with covering caps L. After the cells are in place, the space in the shell above the block B is filled up with a composition composed of beeswax, rosin and linseed oil. The cover K is then adjusted and the cell permanently closed.

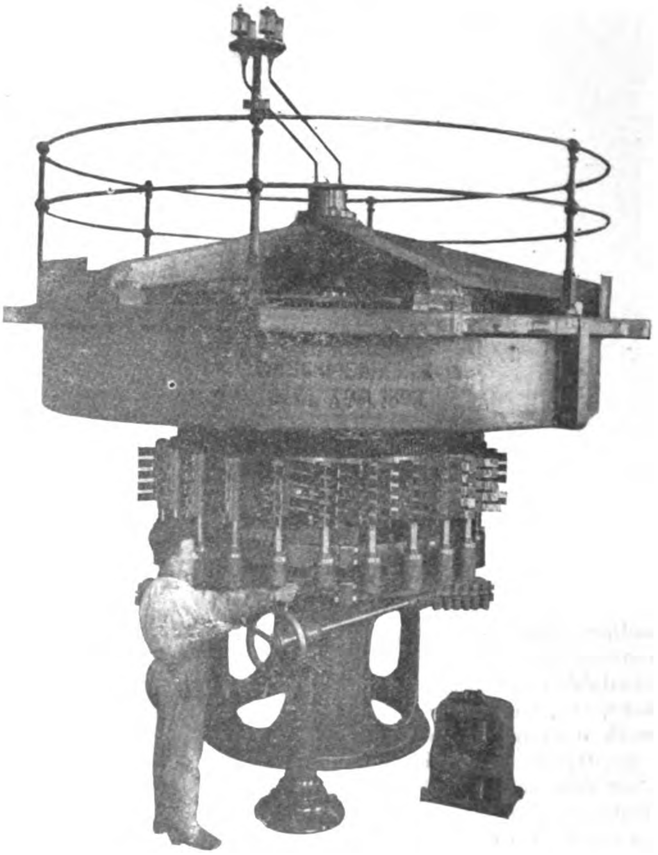
The results obtained with this cell are most remarkable. Thus, when submitted to temperature changes ranging over 200 degrees Fahrenheit, Mr. Weston was unable to detect any variation of E. M. F. greater than $\frac{1}{100}$ of 1 per cent. Another valuable feature of the cell consists in the fact that it has an E. M. F. very close to unity, its actual value being 1.019 volt.

OERLIKON 7,500 AMPERE DYNAMO FOR METALLURGICAL WORK.

ONE of the most interesting electrical plants in Europe is that of the Aluminium-Industrie-Action-Gesellschaft Neuhausen, of Neuhausen, Switzerland, who utilize the water-power of the celebrated Falls of the Rhine. Up to the present four dynamos of 150 h. p. each, one of 300 h. p. and two of 600 h. p. each have been in operation. The additions to this plant, now nearly completed, comprise four new generators, designed to give 7,500 amperes at 55 volts pressure, making 150 revolutions per minute. There will be six dynamos of 600 h. p and one of 300 h. p. in one room, representing an aggregate capacity of 3,900 h. p.

The work at Neuhausen is a continuous one in the fullest sense of the word, just like that of a blast furnace. The machines are called upon for the very highest conceivable duty and it need hardly be pointed out, that the huge commutators and the sets of 120 brushes per machine must and do work entirely sparkless. There is but one man in charge of three to four dynamos of this size. The gates of the turbines and the brushes of the respective dynamos are controlled from the same point.

The accompanying engraving is a reproduction of a photograph taken in the assembling room of the Maschinenfabrik Oerlikon, near Zurich. This dynamo of over 400 kilowatt capacity has a vertical shaft, which is directly coupled with the turbine shaft. The star-like bracket on top of the magnet frame contains the top bearing of the dynamo shaft ; the magnet has 24 radial inward pole-pieces, the whole being of cast-iron and supported by heavy iron structures, not shown in the picture.



OERLIKON 7,500 AMPERE DYNAMO FOR METALLURGICAL WORK.

The dynamo shaft carries the armature and the commutator, a total weight of revolving masses of about 12 tons. The 120 brushes can be moved within certain limits by means of a hand-wheel. The magnetic proportions are such that there is but very little shifting of the brushes at varying loads. The machines are shunt wound and self-exciting. The dynamo may be said to occupy two stories, and the turbine a third one. To give some idea of the size of the dynamo, an ordinary-sized man and a small continuous current Oerlikon standard dynamo of 120 volts and 20 amperes at 1,300 revolutions per minute is shown beside the large machine.

The turbines to run the generators have been built by Messrs. Escher, Wyss & Co., of Zurich, Switzerland. They are provided with a device for hydraulically counter-balancing the weight of the revolving parts and to thus relieve the bottom bearing of vertical thrust.

The buildings as well, as the tunnel to carry the water are the work of Messrs. Escher, Wyss & Co., of Zurich.

THE COST OF MUNICIPAL ELECTRIC LIGHTING AT TOPEKA, KAN.

MR. LEWIS KINGMAN, city engineer, Topeka, Kan., sends us an interesting communication with regard to the cost of operating the municipal electric light plant. His contention is that the figures are different from those given by Mr. H. A. Foster, in his article in THE ELECTRICAL ENGINEER of March 29, page 309. We may remark that Mr. Foster is not responsible for the figures, but simply used the statistics put forward by Mr. Finley in support of municipal lighting. If their bearing was unfavorable, it was not the fault of Mr. Foster.

It appears that the Topeka plant cost $55,447.98, of which the lot and building cost $8,559.33 and the plant, poles and wires, $46,888.65. It is an Indianapolis Jenney arc plant consisting of six dynamos of 30 lamp capacity each. The station is located beside a railroad switch. The dynamos are driven by the boilers and three engines, working up to 235 h. p. There are six circuits with 24.72 miles of line and 33.5 miles of wire, carried on 943 30-foot poles. The lamps themselves are suspended from 40-foot poles at street intersections. The majority of the lamps are 1,100 feet apart one way and 800 feet the other. In all there are 184 lamps in use, of 2,000 c. p. rated. A test of 17 lamps is said to have shown 23.15 volts, 19 amperes, or 1,953 c. p. nominal. The best lump coal is used at an average cost of $2.75 per ton.

Number.	YEAR AND MONTH.	Nights Run During Month.	Hours Run During Month.	Average Number of Hours Run.	COAL.		COST OF COAL PER HORSE POWER.		Cost of Carbons.	Cost of Globes.	Cost of Oil and Waste.	Cost of Repairs.	Expenses Insurance, Telephone.	Pay Roll of Superintendance and Labor.	Interest on Cost of Plant at 6 per cent.	Entire Expense per Month.	Cost per Lamp per Month.	Cost per Lamp per 100 Hours.
					Tons.	Cost.	Per Night.	Per Hour.										
							Cents.	Cents.										
1...	November, 1889	28	340.08	12.14	236.00	$566 40	8.60	0.71	$110 07	$13 50	$22 15	$12 15	$32 88	$483 32	$277 24	$1,517 71	$8 25	$2 43
2...	December, 1889	29	373.47	12.88	261.00	626 40	9 19	0.71	142 40	8 25	27 27	133 74	29 58	531 00	277 24	1,775 88	9 65	2 59
3...	January, 1890	29	357.40	12.33	222.00	532 80	7.82	0.63	142 40	18 75	26 93	167 97	30 68	497 50	277 24	1,694 27	9 21	2 58
4...	February, 1890	26	298.73	11.49	216 90	520 56	8.52	0.74	123 00	9 00	23 31	154 89	28 58	496 25	277 24	1,632 83	8 88	2 97
5...	March, 1890	27	274.83	10.18	194.85	459 40	7.24	0.71	123 00	13 00	23 45	180 13	29 58	498 00	277 24	1,603 80	8 71	3 17
6...	April, 1890	30	265.42	8.84	190.00	456 00	6.47	0.73	109 67	13 38	25 49	90 21	32 59	509 75	277 24	1,514 13	8 23	3 11
7...	May, 1890	28	171.92	6.14	156.60	374 40	5.69	0.93	70 27	8 17	24 06	27 47	29 38	508 33	277 24	1,319 32	7 17	4 17
8...	June, 1890	27	132.91	4.92	76.00	182 40	2.87	0 58	50 90	3 50	32 25	94 07	31 83	516 50	277 24	1,188 69	6 46	4 86
9...	July, 1890	28	146.34	5.23	110.40	283 86	4.31	0.82	50 00	3 50	19 60	100 78	37 93	523 38	277 24	1,296 29	7 04	4 82
10...	August, 1890	28	182.50	6.51	144.00	345 60	5.25	0.80	70 27	2 50	21 36	57 90	33 48	515 75	277 24	1,323 10	7 19	3 94
11...	September, 1890	27	211.69	7.87	154.30	408 66	6.36	0.81	81 98	5 00	25 32	48 95	32 73	516 50	277 24	1,391 38	7 56	3 56
12...	October, 1890	25	204.04	8.16	110.00	361 11	6.15	0.75	79 56	5 00	22 10	64 72	34 48	467 75	277 24	1,311 96	7 13	3 50
13...	November, 1890	24	206.00	8.58	126.35	385 87	6.83	0.80	74 02	9 00	22 00	79 78	49 03	523 41	277 24	1,419 85	7 72	3 75
14...	December, 1890	25	198.25	7.93	123.40	373 70	6.36	0.80	83 65	3 50	15 61	86 11	31 78	525 00	277 24	1,396 59	7 59	3 83
15...	January, 1891	24	189.17	7.88	122.65	374 08	6.63	0.84	71 70	6 00	19 89	100 29	38 08	530 25	277 24	1,417 53	7 70	4 07
16...	February, 1891	21	157.50	7.50	83.75	249 18	5.05	0.67	65 72	3 50	17 30	195 94	33 26	529 50	277 24	1,371 64	7 46	4 75
17...	March, 1891	23	156.50	6.80	102.80	302 73	5.60	0.81	71 70	2 50	13 83	102 11	36 73	528 98	277 24	1,336 82	7 26	4 60
18...	April, 1891	21	141.83	6.75	109.00	317 42	6.43	0.95	64 80	3 00	13 98	41 35	37 36	525 75	277 24	1,280 90	6 96	4 90
19...	May, 1891	23	127.05	5.52	101.00	294 99	5.46	0.99	60 00	3 00	10 30	56 20	45 56	525 00	277 24	1,272 38	6 92	5 45
20...	June, 1891	23	118.08	5.13	86.80	264 74	4.89	0.95	55 20	4 00	9 92	56 04	47 46	525 00	277 24	1,239 60	6 68	5 66
21...	July, 1891	27	138.75	5.14	75.12	230 73	3.63	0.71	55 80	4 00	10 36	39 80	40 91	525 00	277 24	1,183 84	6 43	4 63
22...	August, 1891	28	172.05	6.14	90.10	274 80	4.17	0.68	72 00	2 00	14 62	67 57	33 31	525 00	277 24	1,266 54	6 88	4 00
23...	September, 1891	30	251.05	8.37	108.95	331 55	4.70	0.56	72 00	3 00	20 70	171 95	36 61	525 00	277 24	1,437 05	7 81	3 11
24...	October, 1891	16	140.75	8.79	106.00	323 30	8.60	0.98	60 00	2 00	10 85	730 69	35 16	510 00	277 24	1,949 24	10 59	7 51
25...	November, 1891	28	244.41	8.73	136.45	395 70	6.01	0.69	96 00	6 00	19 50	110 59	35 86	533 10	277 24	1,473 99	8 03	3 29
26...	December, 1891	27	227.50	8.43	143.20	415 28	6.54	0.77	90 00	4 00	12 40	74 29	33 01	525 97	277 24	1,432 19	7 78	3 43
27...	January, 1892	25	214 33	8.57	142.40	412 96	7.08	0.82	84 00	4 00	12 62	147 75	34 06	523 75	277 24	1,496 38	8 13	3 80
28...	February, 1892	23	204.00	8.87	160.40	465 16	8.60	0.97	79 20	4 50	12 47	27 87	34 71	525 00	277 24	1,436 15	7 75	3 80
29...	March, 1892	24	190.35	7.93	134.60	390 34	6.92	0.87	72 00	3 00	12 33	88 87	33 06	525 00	277 24	1,401 84	7 62	4 00
30...	April, 1892	22	148.05	6.73	103.15	299 14	5.78	0.86	66 00	10 00	7 44	260 15	34 71	527 25	277 24	1,481 93	8 05	5 44
31...	May, 1892	27	171.08	6.33	107.10	310 59	5.05	0.79	66 00	29 25	16 44	54 97	33 86	525 00	277 24	1,313 35	7 13	4 17
32...	June, 1892	22	117.50	5.34	78.50	227 00	4.39	0.82	48 00	6 00	8 65	674 93	39 56	525 00	277 24	1,806 38	9 81	8 35
33...	July, 1892	25	126.91	5.07	78.75	228 38	3.88	0.76	48 00	2 00	7 83	46 90	30 96	525 00	277 24	1,166 31	6 34	4 99
34...	August, 1892	26	156.83	6.03	97.50	272 85	4.46	0.73	60 00	6 00	11 94	82 92	35 66	528 22	277 24	1,274 83	6 92	4 41
35...	September, 1892	25	192.00	7.68	124.00	355 51	6.06	0.79	60 00	6 00	11 04	104 25	35 11	531 64	277 24	1,374 82	7 47	3 89
36...	October, 1892	27	202.75	7.51	134.87	391 12	6.16	0.84	84 00	6 00	12 00	221 71	34 86	536 00	277 24	1,562 93	8 49	4 18
37...	November, 1892	26	231.33	8.90	178.25	499 10	8.19	0.92	96 00	4 00	13 50	33 48	33 91	526 00	277 24	1,483 23	8 06	3 48
38...	December, 1892	26	237.50	9.13	152.25	426 30	6.97	0.76	72 00	2 00	12 00	57 99	33 66	525 00	277 24	1,406 28	7 64	3 22
	Totals	970	7,622.80	7.86	5,078.60	$13,924 64	Av. 6.11	Av. 0.777	$2,981 31	$235 80	$642 70	$4,847 57	$1,829 96	$19,743 85	$10,535 12	$54,240 95	Av. $7 75	Av. $3 86
	Per cent. of total expense					25.67	....	....	5.51	0.43	1.18	8.93	2.45	36.40	19.43	100.00	....	....

SCHEDULE SHOWING COST OF 38 MONTHS' MUNICIPAL ELECTRIC LIGHTING AT TOPEKA, KAN.

THE BUDA-PESTH TELEPHONE "TICKER" SERVICE.

IN a recent issue we gave a short account of a telephone "Ticker" service recently established in Buda-Pesth, Hungary, and we are now able to give further details of this novel undertaking. The service extends from eight in the morning until nine at night continuously, communications being alternately sent out in Hungarian and German. The news consists of foreign intelligence, telegrams, exchange quotations, lottery drawings and interviews with prominent persons. It is expected in the near future to add to these a feuilleton, art news and theatrical news.

The work of this curious exchange is done in four large halls where clerks prepare the matter to be telephoned. A fifth room contains the Hungarian and German "speakers" who talk alternately into the various transmitters suspended from the ceiling. The idea of this telephonic distribution of news is due to the late Mr. Puskas, who was at the head of the undertaking. The cost of the service amounts to about 75 cents per month.

EXCITATION OF VACUUM TUBES.

IN a patent just issued to Mr. H. T. Barnett, of London, he describes a method of simultaneously illuminating a number of vacuum tubes by an electric discharge whether the tubes are all alike or of widely different sectional area and length, and also when two or more tubes or series of tubes are arranged in parallel.

The arrangement consists in placing condensers on opposite sides of an independent glass plate, one set of these condensers being connected with a series of vacuum tubes, while the others are connected with the leads. The several condensers have an inductive capacity proportional to the minimum sectional area of, or to the degree of illumination required in, the particular tubes with which they are combined so that by this means the electric discharge produced through each path is kept under control.

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY.—XVII.

BY

A. E. Kennelly

It is evident that the pull, varying with the cube of the radius, is proportional to the volume of the particle, so that if a given mass of iron be divided into spherical portions, and the distribution of prime flux round all of these is similar, the total pull on the whole mass will be the same, no matter how small the individual spherical diameters may become. In practice, however, the crowding of a number of spheres into close proximity will influence in some degree the flux distribution. For while the flux density might be sensibly uniform for example, when the spheres remain scattered apart, when closely packed the prime intensity round any one sphere will contain the additional return local flux external to neighboring spheres.

The formulæ also show that if the resultant attractive force is to be made as great as possible $\left(B\dfrac{dB}{dx}\right)$ must be a maximum, and it is useless to provide a powerful flux unless its gradient is also considerable, a consideration that merits a more detailed examination.

Suppose a small wooden cylinder, drum-shaped, say 1 cm. long, and also 1 cm. in diameter, whose two faces are denoted respectively by the letters E and X, to be placed in a magnetic flux, and so fixed, that E is perpendicular to the direction of B, so that the flux enters normally on that face. Then, because there is no absorption or generation of flux within the cylinder, this quantity entering, namely, 0.7854 B C. G. S. lines, must emerge from the drum, either through the sides, or through X. If all emerge through X, the flux is uniform within the limits of the cylinder, whose sides act as a channel or tube of flow. If, however, some flux emerges through the sides, the density of the flux finding exit at X will be diminished, since the flux is dispersing. If on the other hand the flux is converging, it will enter through the sides and E, leaving entirely through X. Suppose in this case that the density at E is 1,000 C. G. S. lines, so that 785.4 lines pass through E; then if 200 more lines come in through the sides, 985.4 will leave through the face X, and the rate of increasing density along the direction of B will be here 200 lines per cm. or $\dfrac{dB}{dx} = 200$. The attraction therefore of such a field upon particles of magnetizable material placed therein depends upon the local number of lines that would enter or leave the sides of an imaginary small drum set with its axis along the local direction of B, and the direction of motion would always be towards the denser flux. In other words, the prime flux must be either convergent or divergent, if resultant magnetic stresses are to be exerted upon the particles.

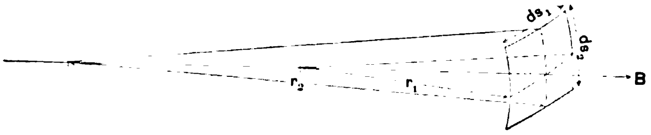


FIG. 36.

The essential accompaniment of such convergence or divergence is a concavity or convexity in the equipotential surfaces controlling the flux. In fact, if we take an equipotential surface of any shape, and cut out in it, Fig. 36, a little spherical rectangle of sides ds_1 and ds_2, the flux traversing the rectangle will be $B . ds_1, ds_2$. Also if r_1 and r_2 be the radii of curvature of the sides ds_1 and ds_2, respectively,—the radii of circles that would locally coincide with these sides,—measured along the direction of B positively, it will follow that $\dfrac{dB}{dx} = B\left(\dfrac{1}{r_1} + \dfrac{1}{r_2}\right)$; or, the rate of change in B is its product with the sum of the local curvatures in any two perpendicular planes. Thus, when the equipotential surface is plane, r_1 and r_2 are both infinite, and $\dfrac{dB}{dx} = 0$, or the flux, as we know, is uniform.

Since by this last result the formula for the pull of a prime flux upon a magnetizable sphere may be written $P = r^3 B^2 \left(\dfrac{1}{r_1} + \dfrac{1}{r_2}\right)$, it follows that for a simple magnetic circuit—a coil without iron core—the attraction on particles in the circuit will vary at any given point as the square of B, and consequently as the square of the exciting current, for not the shape of the equipotential surfaces, but only their numerical values, will alter with the exciting current, and the sum of the curvatures at any point will remain unchanged. In practice this is nearly true for ferric magnetic circuits with large air gaps such as bar electromagnets, but is of course often far from being true with ferric circuits nearly closed, for near the saturating point of the iron core the changes in the form of equipotential surfaces and of their gradient consequent upon changes of excitation may vary considerably.

In the case of an ordinary permanent or electromagnet, the equipotential surfaces crowd together as the poles are approached, their curvatures at the same time increasing, so that both B and $\dfrac{dB}{dx}$ are usually a maximum at the poles, but should the core of the electromagnet be cylindrical, so that its poles are comparatively wide flat surfaces, the equipotential surfaces close to the poles are almost planes, while at the edges they bend much more sharply. The result will be that while there may not be much difference between the values of B (or the distance between successive equipotential surfaces), at emergence from the pole, in the centre, or at the edge, there will be a considerable difference between the rates of flux divergence at these positions, as indicated by the local curvatures, and the product of $B\dfrac{dB}{dx}$ will be much greater at the edge. In fact it will sometimes happen in practice that a powerful electromagnet with broad flat polar faces when plunged into iron filings will become densely packed with these particles round the polar edge, while the centre is left almost entirely denuded. In this or similar circumstances, lies perhaps the foundation for the supposition sometimes entertained, that magnetism principally resides in, or acts at, points. However valuable the curves assumed by scattered iron filings may be in delineating the distribution of flux, the undue prominence that they give to polar points and edges has to be borne in mind. The particles really indicate the distribution of $B\dfrac{dB}{dx}$, and not B simply.

Other things being equal, the best form of pole piece for an electromagnet to possess, in order to attract iron particles, is conical. If on the contrary it is required to sustain the largest mass of particles, the flat pole disc is generally preferable, for while the centre will be almost inactive, the long circular edge may more than compensate.

POOL-ROOMS AND TELEGRAPH REVENUE.

IT is alleged that the Western Union Company derives a gross revenue of about $2,500,000 a year from the pool-rooms of New York, and stands to lose this by the closing up of those dens of vice. There are about 250 pool-rooms in New York State.

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Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
Western Editor and Manager, L. W. COLLINS, 575 The Rookery, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. HANKS.
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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

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ELECTRIC RAILROADS AND ELECTROLYSIS.

THE difficulties which were met in bringing electric railroading to that point of perfection at which it was accepted as a practical commercial system of operation, capable of earning dividends, had hardly been overcome, when it seemed for a time as if its progress was to be retarded by other unforeseen difficulties which cropped up in its path. The first of these, and which for a time indeed threatened seriously to interfere with the progress of the electric railroad, was the objection made on the part of the telephone people to the disturbances caused by the railway wires. These disturbances were of a dual nature, due in part to the direct induction from wire to wire, and second, to the railway current entering the telephone lines by way of the ground in its effort to return to the central station by the path of least resistance. Leaving aside the fact that the remedy for both these classes of disturbances can be readily effected by the observance of proper methods of construction on the part of the telephone people, the Courts have decided that the operators of the electric railway have a legal right to the use of the ground as a return circuit. But it would appear that there has developed quite another aspect in this case and one which electric railway managers would do well to consider seriously, for the reason, that the difficulty which has arisen is likely to affect a larger number of people than could possibly be contended for in the case of the telephone. We refer to the action of the railway current on water pipes and other metallic conduits placed underground in proximity to the electric railway. We need scarcely draw attention to the fact, that in many instances, auxiliary ground return wires have been largely reduced in effective cross section by electrolytic action, and this fact has indeed proved so great a source of annoyance that the use of such auxiliary conductors has in more than one instance been abandoned; their place being taken by ground plates connected to the rails and sunk into the earth at frequent intervals.

Attention has again been drawn to this subject in a paper read by Mr. C. H. Morse before the New England Water Works Association, in which he refers to the injury done to water pipes in and about Cambridge, Mass., from the cause above mentioned and the attempts which have been made to overcome it. The most obvious remedy is that of grounding the negative side of the generators so that the current enters the pipe from the ground, instead of emerging from it, as would be the case if the positive were grounded. This has been tried with good effect, precaution being taken, however, to make the connection between the water pipes and the power house so that there shall be practically no difference of potential at this point, or, in other words, that the current would take to the conductor in preference to the earth. Evidently the principle embodied in this construction is the one underlying the whole question of immunity from the deleterious effects of electrolysis. Where electrolytic action of this nature has occurred it must be due evidently to a difference of potential created at various points in the ground return due to the insufficiency of such ground, and hence the reliance to be placed upon ground plates must be determined largely by the nature of the ground.

It seems to be a prevailing opinion among many that the ground forms a circuit of practically no resistance, and that a conductor sunk anywhere will serve to carry the current to a second ground at a distance with practically no loss. Nothing could be remoter from the truth, and we would go even further and maintain that for heavy current work ground returns ought only to be employed as auxiliaries and as an aid, rather than as the sole means of current return. We are well aware that in some instances this is the sole method adopted for conducting the current back to the generating point; but to hold up these instances as examples to be followed would be fatuous.

But there is another aspect of the case which deserves consideration. It having been shown that in many intances the current takes to the water pipes and other conductors in the ground by preference, it must be obvious that if the current can be made to return to the generating point *exclusively* by such conductors without utilizing the earth, all difficulty will be obviated, and this is one of the plans which has been suggested, and results from which will be watched with much interest. A beginning of this kind will soon be made near Boston, where a special line of feeders will be run from the central power house to the different parts of the city, and will not be connected with the machines at all but will be connected with the water pipes to the station and with the pipes in all sections of the city.

With the results of the past few years before us, it would appear that electric railway constructors have as yet hardly mastered the problem of getting the full value of the rail itself as the return conductor, or, to be more specific, it is obvious that much improvement is still to be made in the use of that small but highly important detail, the "rail-bond." It must stand to reason that there are few cases in which the cross-section of the rail itself is inadequate to return the current without a prohibitive loss, and that the weak point is therefore the connection between rail and rail. Do constructors see to it that they use the best rail-bonds available or possible?

We have indicated here the difficulties met, and still to be met, without attempting to present a final solution for them, but the subject is one which must sooner or later force itself upon the attention of street railway managers. We shall be glad to devote space in our columns for its thorough discussion, and to record improvement. If the improvement do not come from within, it will be forced upon the industry by a public indignantly averse to the disappearance of the water pipes, or by gas companies furious at finding such an insidious attack made on them by electricity.

FOREIGN AND AMERICAN PATENTS.

Commenting upon the ruling of the Supreme Court in the appealed case of Huber *vs.* Nelson Manufacturing Company, some of our daily contemporaries jump to the conclusion that under that ruling the Edison carbon telephone patent must be held void because of the expiration of foreign patents before the issue of the American patent. In the case decided recently it appeared that the British patent had become void not only before the issue of the United States patent but before the date of the American application. The Edison application, however, was filed some fourteen years before the issue of the patent in 1891. The exact relations of application dates and issue dates of American and foreign patents to the interpretation of section 4889 seem never to have been conclusively passed upon by the Supreme Court. The status of the Edison telephone patents as well as that of other important patents would seem to depend upon the clearing up of this point.

THE "FEEDER AND MAIN" PATENT.

If the upholding of the validity of its patents is a source of gratification, the General Electric Company must certainly feel elated at its latest triumph—one of a lengthening series—achieved by the decision of Judge Green in the celebrated "Feeder and Main"-case. Although the specifications, and the claims, as printed last week, refer only to the maintenance of uniform potential on lighting circuits it is more than probable that the owners of the patent will seek to extend its scope so as to cover the feeder systems adopted in electric railway work. It may be pointed out, however, that owing to the expiration of the English patent granted Sept. 24, 1880, the United States patent has but little more than a year to run. Another point, perhaps, is whether a feeder would not cease to be a "feeder" by the mere intercalation of one or two consumption devices, making it a "main." Again it may be questioned whether the interposition of a converter or a motor-dynamo, or a railway motor, would not be outside the scope of the claims of the patent. It is on this very point that one of the experts for the Edison Company testified that, in his opinion, such devices were not included within the meaning of the claims, which he considered to be limited strictly to lamps. With such admissions on record it seems hardly probable that the General Company will seek to levy tribute from others than the operators of direct-current lighting stations equipped with feeders. The number of these not already holding licenses from the original Edison Electric Light Company, or protected by agreement with the old Thomson-Houston Electric Company, is probably so small that the judgment just obtained may turn out to be of little more than historical interest.

ELECTRIC MACHINE TOOLS.

It has been remarked that it requires ten years for the most obvious truth to penetrate the minds of the public after it is first promulgated, and the growing electrical arts probably furnish as good examples of this as could be wished for. After years of speculation, enlivened with but few sporadic attempts at its practical solution, the problem of driving machine tools by electric motors forming an integral part of the mechanism is at last being seriously attacked. In this week's issue of the Engineer, Dr. S. S. Wheeler shows in what a simple manner the most universally employed machine tools can be equipped. From the work already accomplished, as revealed in this very interesting and pithy article, we feel certain that the best equipped shops will, in the near future, adopt the direct-driven electric tool with much the same spontaneity as that which attended the introduction of the electric street car motor, once its merits had been demonstrated.

AN EMERGENCY BRAKE FOR ELECTRIC CARS.

A device for stopping electric cars instantly in cases of emergency is being manufactured by the Automatic Car Fender Company, and was recently successfully tested on the Troy City Railroad at Troy, N. Y., both on the level and on one of the steep grades with which the streets of the town abound. The spring brake fender, as it is called, consists of a 2½ inch shaft just in front of the forward wheels, bearing 16 steel springs, projecting downward, and normally held just clear of the ground like an ordinary fender. A lever, extending through the platform, controls a weight, which, when released, allows the fender to fall upon the ground while the weight and momentum of the car force the springs tightly against the pavement and arrest the movement of the car body. At the same instant, a brake is strongly forced against the wheels by the turning of the shaft to which the fender is fixed, and the current is automatically cut off.

The great advantage claimed for this divice is that it will work with equal facility whatever the condition of the track.

ELECTRIC BUOYS AT JACKSON PARK.

In his report to the Lighthouse Board on the subject of establishing a line of electric buoys from the foot of Van Buren street, Chicago, to the Fair grounds, Captain Schley, U. S. N., suggests running separate lines of single-conductor, single armor, cable from a two-conductor, lead-covered, cable laid in a subway along the beach, directly to each buoy. This would require about 17½ miles of cable and, it is estimated, would cost, complete $18,000. Congress has already appropriated $20,000, and the work will be commenced as soon as practicable. Captain Schley is of the opinion that the system in use at Sandy Hook would not do in this case because of the greater distance of the buoys from the source of current supply.

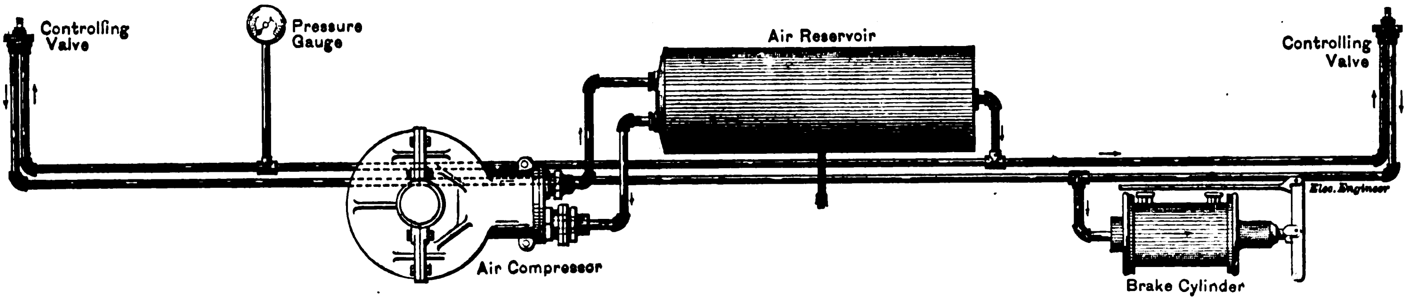
We understand that Capt. Schley has since modified these plans and that it is now intended to light the buoys by converters mounted on the buoy spars. The converters will be operated in series. By this method the feeding cable may be run in one continuous length without taps, which would be likely to give trouble from leakage.

ELECTRIC RAILWAY DEPARTMENT.

THE CHRISTENSEN AIR BRAKE.

An interesting test of a new form of automatic air brake for street railway service was recently made on one of the cars of the Detroit Citizens' Street Railway Company. The brake, shown in detail in the accompanying illustration, is the invention of Mr. N. A. Christensen, general manager of the Chicago Street Car Air Brake Company, and seems to be very simple in construction and efficient in operation.

The compression of the air is effected by an automatic, self-contained compressor taking power from one of the car axles, and the brake is controlled by a small crank similar to the switch lever on electric cars. It is worked independently of the existing hand brake, which is used merely as an auxiliary. The compressor is hung on the axle and contains a combined suction valve and regulator. When the pressure is less than that at which the regulator is set, the suction valve is operated like an ordinary air compressor. When the required pressure is reached, however, the seat of the suction valve is automatically removed by the governor, and air is admitted and discharged without resistance. The compressed air is stored in a reservoir from which pipes lead to the controlling valves at each end of the car. When air is admitted to the brake cylinder the pressure in the reservoir decreases to about 1½ pounds, increasing rapidly to that at which the regulator is set when the car again starts.



The Christensen Air Brake For Electric Street Cars.

All parts of the mechanism are easily accessible and the oiling is done from a single point. The eccentric to which the compressor piston-rod is attached is wholly enclosed and may be submerged in oil, if desirable.

The company manufacturing this brake have so many large orders on hand that the capacity of their factory is exceeded, and they have been compelled to sublet the making of some of the parts in order to keep up with the demand.

AN ELECTRIC LAUNCH FOR A TACOMA STREET CAR LINE.

The Point Defiance Street Railway is building a 56 foot storage-battery electric steamer named Mount Tacoma, to be put on the Gig Harbor and Floating Dry Dock route, in connection with its street car lines. The steamer is an experiment, but the inventor, Nickolas Lawson, anticipates no special difficulty.

The vessel will use a storage equipment of 75 cells for 12 hours' service. Each cell will be 15 inches deep and 14 by 14 inches in area. There will be no other ballast than the battery, which will be placed between the beams and the ceiling at the top of the keelson. Everything, including the motor, will be out of sight, and all the space will be devoted to passengers. The battery will be charged at night from the trolley wires.

The vessel will have a breadth of beam of 10 feet and depth of four feet, and will be built for a regular speed of 15 miles per hour, which can be made 20 if need be. The boat is to be the leader of a number to be placed on Puget Sound routes.

STREET RAILWAY TRANSACTIONS IN THE SOUTH.

A special dispatch from Memphis, Tenn., of March 29, says:—"A. N. Billings of Chicago, the principal owner of the Citizens' Street Railway Company, which operates all of the electric lines in Memphis, with one exception, is preparing to sell his property to a New York syndicate, of which Jacob Seligman, the banker, is the head. The amount offered Mr. Billings for his interest is $1,500,000. He left for New York yesterday to close the deal. The Seligman syndicate recently purchased the St. Charles Street Electric Railway of New Orleans, and it is said that a movement is on foot to buy the street-railway systems of Memphis, Nashville, Chattanooga, Birmingham, Montgomery, Mobile, and Atlanta."

Jacob Seligman declared himself ignorant of the transactions stated in the despatch above and referred the newspaper reporters to Henry Seligman, who, after reading the despatch, said: "There is no truth in it for the present."

THE PRESENT STATUS OF THE STORAGE BATTERY.[1]

BY JAMES K. PUMPELLY AND C. SORLEY.

The aim of all makers of storage batteries since the Faure battery came out has been to so construct a battery that it should be impossible for the active material to fall off the plates. This has been accomplished in various ways, but almost invariably the result has been the introduction of another serious defect, namely, greater internal resistance and therefore less efficiency.

One of the greatest stumbling blocks in the way of inventors, who have tried to find a means of keeping the active material from falling off the plates, has been the universally accepted idea that it is absolutely necessary to have a free circulation of the solution. After a long series of experiments we have found that this is not necessary, providing a porous and also absorbent substance (capable of absorbing the sulphuric acid as fast as it is made in charging) has been placed between the plates. This enables us to jam the plates up close together, and so make one solid compact mass of the element, without any falling out of material and without any free solution to spill over everything when the battery is used for traction and other analogous purposes, and it also adds a number of years to the life time of the battery.

By a process discovered by Mr. Sorley, we have succeeded in developing a Planté battery in which the active material is made electro-chemically, in one hour and 50 minutes. (The authors here showed such batteries containing all the latest improvements).

The battery shown contains an element that only measures 6″ x 6″ x 6½″ but which has a capacity of 177.7 ampere hours at a discharge rate of 23 amperes. It is possible to discharge it at as high a rate as 75 to 85 amperes for, say, 20 minutes which is ample time to climb an electric railway a grade, and this discharge of, say, 80 amperes for 20 minutes, will not lower the voltage more than one $\frac{5}{100}$ of a volt; that is to say, the E. M. F. during this large discharge from so small a cell will remain constant at 1.95 volts.

The plates in this cell are made from one integral sheet of lead, $\frac{3}{8}$ of an inch thick and prepared for treatment by a new method, which does away with all joints or soldering, thus avoiding any chance for local action. And aside from this, the process greatly cheapens the cost of making the plate.

FIRE IN A NEWARK, N. J., CAR HOUSE.

The car house used by the New Jersey Traction Company situated at the corner of Central avenue and 14th street, Newark, N. J., was burned to the ground at 2.10 a. m. April 3d. Twenty-seven cars were destroyed and the total loss was $100,000. The fire had its origin in the room used for lamp filling. The car house was 250 feet long by 60 feet wide and was used not only for cars, but for motor repair work and for supplies.

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1. Abstract of a Paper read before the Chicago Electric Club, March 20, 1893.

MISCELLANEOUS.

RECENT IMPROVEMENTS IN D'ARSONVAL GALVANOMETERS.[1]—I.

BY NELSON H. GENUNG.

Marcel Deprez,[2] about the year 1880, introduced into galvanometer construction what has since proved an important and desirable modification. He placed the needle of the ordinary galvanometer between the poles of a powerful horseshoe magnet, thus freeing it from all local magnetic disturbances and giving it a short period of oscillation, but at the same time causing it to lose almost entirely its sensibility. He afterwards substituted a soft iron laminated needle which when placed in position became strongly polarized by induction. Fig. 1 shows the general arrangement adopted by him, and known under the name "*galvanomètre à arête de poisson*," galvanometer of herring-bone work. The soft iron needle A is mounted within the galvanometer coil B, and both are surrounded by the horseshoe magnet N S. The range of movement of the needle is, however, very small and the deflections far from being proportional to the currents measured.

The next step was to retain this powerful control magnet and astaticize the movable system. M. d'Arsonval[3] concluded that so long as the moving parts contained any magnetic material this would be utterly impossible, the directing force being always very great as compared with the deflecting force. In order to accomplish this he aimed at making the directing forces very weak and the deflecting force very powerful, and succeeded by fixing the soft iron needle and making movable the current coil of the Deprez instrument. The control being non-magnetic could be made as weak as might be desired, the deflecting force remaining practically the same. Fig. 2 shows d'Arsonval's arrangement in which N S represents the permanent horseshoe magnet, B, the fixed soft iron tube or needle, C, the coil mounted on knife-edges D D and provided with mercury contacts E E, coinciding with the axis of rotation.

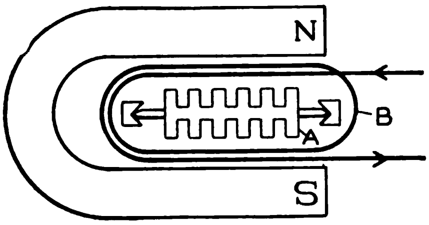

Fig. 1.

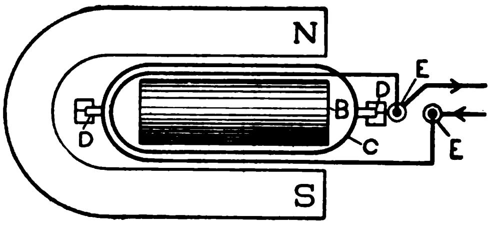

Fig. 2.

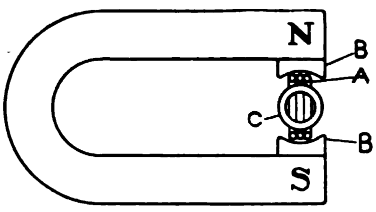

Fig. 3.

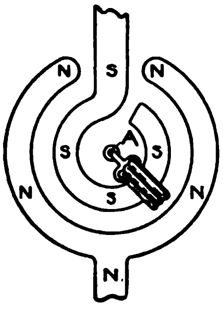

Fig. 4.

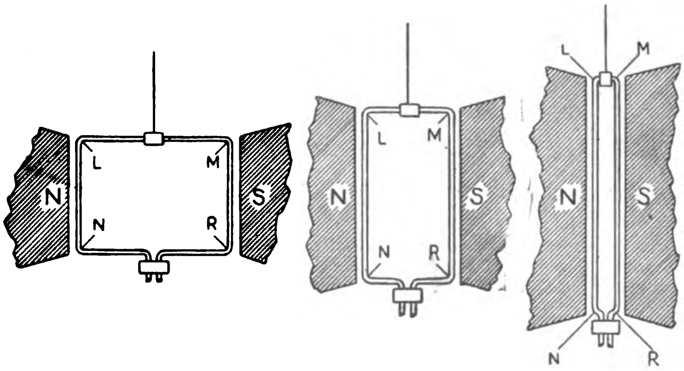

Fig. 5.

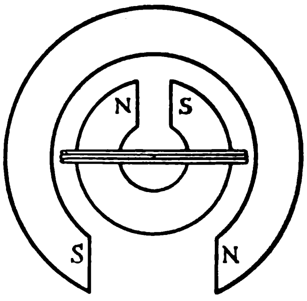

Fig. 6.

Lord Kelvin probably first made use of the above principle in the construction of his siphon recorder used as a receiving instrument in submarine telegraphy. M. d'Arsonval[4] says regarding his own application of this principle: "This apparatus rests upon the same principle as does the siphon recorder of Wm. Thomson. It is seen that I have arrived at the same combination, starting from another point of view and that I have also transformed into a *galvanometer*, an apparatus which up to then had been used only as a telegraph receiver." In the same article he continues, "I have given to this apparatus the name of *Deprez-d'Arsonval galvanometer* in order to recall its origin."

A successful attempt was made in 1884 by Deprez[5] to construct a d'Arsonval galvanometer giving proportional indications. Two soft iron pole pieces circularly cut out were employed. These pole pieces B B, see Fig. 3, and the soft iron cylindrical core C were rigidly attached to the magnet. Within the annular space occupied by the coil A, the magnetic field is strong and uniform and the lines of force are normal to the polar and core surfaces. The coil thus always moves through a uniform magnetic field, cutting the lines of force everywhere normally.

Another arrangement of pole pieces,[6] see Fig. 4, has been proposed which is capable of giving to the coil a much wider range of movement in a perfectly uniform field. This arrangement has, however, one or two disadvantages worth mentioning. The coil being pivoted at the centre A, has a comparatively large moment of inertia, which prevents it from coming to rest so quickly as it otherwise would. The amount of "dead" wire is also very great. By "dead" wire is meant all that portion of the coil not so disposed with reference to the field as to assist properly in the deflection, the "active" wire being that portion which moves properly in the magnetic field. This point is very satisfactorily illustrated in Fig. 5. The portions L N and M R in all three of the coils are so disposed, with reference to the axis of rotation and to the lines of force, as to assist in the deflection. The wire making up these portions is called the "active" wire of the coils. The wire making up the portions L M and N R takes no active part in the deflection, and is, in consequence, called the "dead" wire.

A novel arrangement of coil and magnets has recently been adopted by M. Gaiffe,[7] of Paris, in milliampèremeter construction. He has done away with the soft iron core and makes the deflections proportional to the intensities by employing two magnets of cylindrical form, as shown in Fig. 6. The coil in this arrangement contains a large amount of "dead" wire, being necessarily quite broad, and has a considerable moment of inertia as well. The range of movement, also, is not materially increased.

ELECTRIC SAFETY CURTAINS.

Our esteemed contemporary *Electricity* accuses us of having taken a recent brief item on an "electric safety curtain" from its issue of February 22, "without permission and without acknowledgment." If we have done it an injustice, we hasten to make reparation, but we would point out that its own article was taken direct, without acknowledgment, from a fully illustrated description in *La Nature*, of January 14. Our little note was *not* taken from *Electricity*, but was "boiled down" as a casual news item from an article appearing in the daily papers. It is possible they may have used *Electricity's* article, but, even then, they would probable have given credit to *La Nature* had they known the facts.

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[1] Abstract of a Paper read before the Electrical Section of the Franklin Institute.

[2] "On Electrical Measuring Instruments: Ammeters and Voltmeters," by Marcel Deprez, *La Lumière Électrique*, April 30, and November 5, 1881.

[3] "A new Deprez d'Arsonval Astatic Galvanometer," by M. Deprez, *La Lumière Électrique*, September 7, 1881.

[4] "A Periodic Galvanometer of Great Sensibility," by M. d'Arsonval, extract *de la Revue Internationale de l'Électricité et de ses Applications*, April, 1886.

[5] "On a Galvanometer in which the Indications are Proportional to the Current Strength," by M. Deprez, *La Lumière Électrique*, December 13, 1884.

[6] See *La Lumière Électrique*, March 21, 1888.

[7] *La Lumiere Electrique*, September 3, 1892.

THE MOST ECONOMICAL AGE OF INCANDESCENT LAMPS.[1]

BY CARL HERING.

It is generally supposed that it is an advantage for incandescent lamps to have a long life; the object of this paper is to show that this is a delusion, and that it is not substantiated by facts, but that on the contrary under normal conditions a very much shorter life represents an actual gain in dollars and cents. With the data of Prof. Thomas' paper on "The Life and Efficiency Test of Incandescent Lamps"[2] as a basis I have endeavored in the present paper to deduce some figures to show what the best life of a lamp is, everything considered.

The method by which the best age is to be deduced, is the new and very rational one suggested by Mr. O'Keenan and described in *L'Industrie Electrique*, Nov. 25, 1892, page 510. As it is fully described in these articles I will merely state it briefly here. Calculate *for each hour* in the life of a lamp the *total quantity of light* given off by it in candle-power hours *from the time the new lamp was first started;* similarly, calculating *for each hour* in the life of a lamp the *total cost* of this light, that is, the original cost of the lamp added to the cost of all the energy consumed by it *from the time the new lamp was first started*, up to that particular hour. Now, it is evident that if for each hour in the life of a lamp we divide this total cost up to that hour by the total quantity of light up to that hour, we will obtain the *average* cost of a candle-power hour of light from the beginning up to this hour. From this final data it can readily be shown at what age this total average cost is the least. If based on actual measurements of the lamp made throughout its life, it is evident that this method will give the most rational and only strictly correct way of determining the real cost of the light actually produced. It should be distinctly understood however that this method is based on the actual amount of light produced, and on the actual cost of the power; whenever therefore either or both of these factors are not of importance, the results deduced here are also of less importance. In the present case, the work, which is somewhat tedious, is greatly simplified by taking the data from Table V. in Prof. Thomas' paper giving the watts per mean candle-power. By using the watts per *one* candle-power it is evident that the candle-power curve in the present calculations becomes a straight line, thus reducing the work by more than one-half,

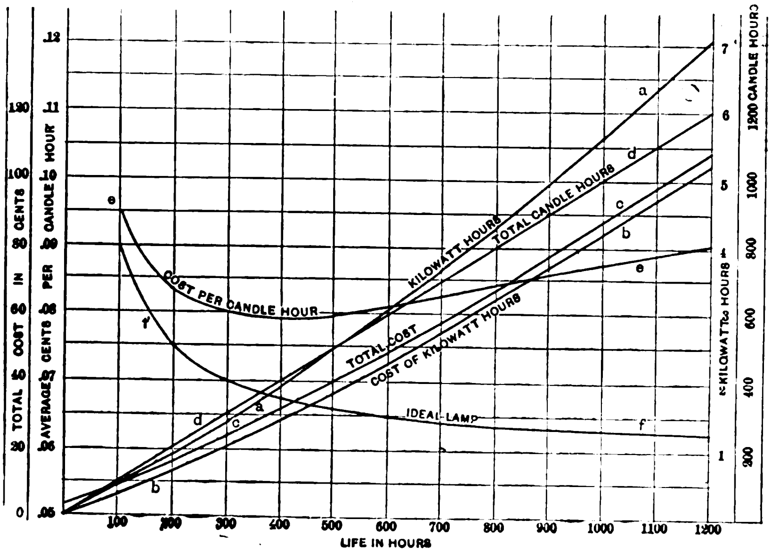

Fig. 1.

To illustrate the method let us deduce the results given for the average lamp. Calculate for each hundred hours the total kilowatt-hours consumed per candle up to that age; the result gives the curve *a* Fig. 1. Multiply these values by the cost of a kilowatt-hour of energy; 15 cents is the price assumed here; this gives curve *b*. Add to these values the original cost of the lamp *per candle*, that is, the total cost of the lamp divided by the candle-power at the start; this gives curve *c* which is evidently parallel to curve *b*. Draw curve *d* representing the total candle-power hours from the start; in this case this line will evidently be straight. These curves, however, need not be plotted, they are given here only to illustrate the method. Now divide each ordinate of the cost curve *c* by the corresponding ordinate of the light curve *d*, and the result is the curve *e* which is the final curve sought for.

This curve *e* gives for each age the cost of a candle-power hour of light, that is, *the average cost for the whole time from the time the lamp was first started, up to that particular hour.* This is the curve which gives us the final results. The interesting feature about it is that it has a minimum point at about 400 hours, which means that at the end of 400 hours you are paying the least for a candle-power hour of light, that is to say, your light is then the cheapest during the whole life of the lamp, all things considered. If you continue to use those lamps longer than 400 hours the *average* price for the light will again increase and will continue to do so. Strange as it may seem, therefore, it is more economical to break the lamp at that age rather than to continue running it, even though this means buying a new lamp. The data assumed in this curve is that the average lamp costs 45 cents and the power costs 15 cents per kilowatt hour. Mr. O'Keenan calls this minimum point by the appropriate name "smashing point." To show the results of an ideal lamp, curve *f* has been drawn. This ideal 16 c. p. lamp costing 48 cents and consuming four watts per candle, is supposed not to blacken or to change in any way.

To show what the curve *e* really means in dollars and cents let us calculate an actual case. If run 1,200 hours the average cost per candle-power hour is .0903 cent or a total of 108.4 cents per candle for 1,200 hours. A 16 c. p. lamp therefore represents a total cost of $17.844 for power and lamp, assuming for the sake of simplicity that it continues to give 16 c. p. If stopped at 400 hours the cost of the light is only .0792 cent per candle hour or a total of 31.7 cents per candle for 400 hours; if renewed three times in the 1,200 hours the cost will be 95.1 cents or $15.22 for 16 c. p. This shows that replacing the lamp after every 400 hours represents an actual saving of 13.3 cents per candle during a period of 1,200 hours or a total of $2.12 saved per 16 c. p. lamp every 1,200 hours. This amount of money represents the cost of almost five lamps at 45 cents which might be interpreted so as to show some very curious results; namely, if you bought eight lamps originally, used only three of them for 400 hours each and threw the other five away, it will, in the long run, cost you the same as to buy one lamp and run it for 1,200 hours, assuming that you are paying for light actually received. As the cost of the light at 400 hours is over 12 per cent. less than that at 1,200 hours, it is an actual saving of 12 per cent. in dollars and cents if the lamps are replaced every 400 hours.

Even for considerable ranges of the price of the lamps and of the power the best age remains at between 300 and 500 hours; the effect of the cost of power is much more important than that of the price of the lamps; the latter is not of so much importance as is generally believed. While there is a minimum point it is not very definitely located as to time, that is, it makes but very little difference if the lamps are replaced at 300, 400 or 500 hours, but after that the difference becomes apparent.

In addition to these curves attention is called to those shown in *L'Industrie Electrique*, Nov. 25, 1892, page 510, deduced by Mr. O'Keenan for foreign lamps, in which the best age is less uniform and somewhat earlier.

Whatever other deductions may be made from this investigation, the most important is that lamps might to advantage be forced much higher than is customary, at the expense of their life. This, though it requires more frequent renewals, will be a gain to the consumer as well as to the central stations; the former will get better and cheaper light, while the latter will be able to increase their output in lights or run the same number of lights at less loss in the mains, or, what is equivalent, run the same number of lamps on considerably smaller mains. How far the lamps may be forced before the other extreme is reached, is a question to be determined when we have the data for such new lamps.

In conclusion I desire to state that while some of the results obtained from the present investigation are somewhat striking, it must not be forgotten that we have been considering the cost of *a candle-power of light;* as it is far more difficult to notice slight differences in the light than it is to notice the bills for lamp renewals, it would not be wise to adhere too strictly to what theory tells us. In practice, therefore, lamps need not be renewed as early as these deductions point out; at the same time, however, the results clearly show that it is absurd to keep lamps running too long, and that the life of our present lamps is more than sufficiently good. Perhaps the best practical rule for renewing lamps is to run them until the diminution in candle-power becomes noticeable; after that point is reached, we may rest assured that it is economical to throw them away.

Queen & Co., Incorporated, Philadelphia, are introducing a Steam Engine Indicator of especial merit, "The Bachelder." This indicator is a new departure from all other forms, the important feature being the flat adjustable spring, by which the change can be made from one scale to another by a simple adjustment of the fulcrum, thus avoiding the extra expense and necessity of carrying a series of spiral springs. This house has also this year put on the market a line of steam and pressure gauges of their own make, for which they claim great accuracy.

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[1] Abstract of a Paper read before the American Institute of Electrical Engineers, New York, February 21, 1893.

[2] *Transactions* A. I. E. E., vol. ix. 1892, p. 271.

LETTERS TO THE EDITOR.

WILLIAM WALLACE AND HIS CONTRIBUTIONS TO THE ELECTRICAL INDUSTRIES.

In The Electrical Engineer of March 9, 1893, appears a letter from Mr. Charles Stowell, whom I have the pleasure of knowing, and who was for a long time connected with the works of both William Wallace and Moses G. Farmer, in which letter he takes exception to certain statements which appeared in my articles upon the above subject in the Engineer of February 1, 8, 15 and 22, 1893. I have carefully read Mr. Stowell's letter, and fear that he has not carefully read my articles. At any rate, it seems to me that he labors under certain misconceptions. If he will carefully examine the portion of my remarks referring to the Wallace dynamo of 1874, he will find that I have referred to the construction of hand dynamos, in which I treated the subject of this form of construction of machine, historically, going back even as far as the early hand-magneto machines with upright "horseshoe" magnets of steel constructed by Pixii, E. M. Clark, Stöhrer, Gramme, and C. W. Siemens.

Mr. Wallace, I believe, also constructed machines which could be driven by hand, but the 1874 machine, illustrated in the Engineer of February 8, was intended to be driven by a steam engine or other source of power, and represented the commercial type of dynamo as we know it to-day; and I think it will be admitted by every one acquainted with the development of the electric lighting art in this country that William Wallace deserves to be considered the founder of the dynamo-manufacturing industry in America.

The quotation which Mr. Stowell makes from the literary proceedings of the Philosophical Society of Manchester (England), is well known to the undersigned, and it is far from his desire to at all discredit the profound ability and originality of Prof. Farmer's work. The reference which I have made to his work in connection with the Wallace article is evidence of this. Mr. Stowell says "in reference to the historical machine known as the 'Telemachon,'": "Mr. Hammer says, 'though I believe it never occurred to any one to try it as a motor transformer' it certainly was sufficiently tried as a motor during the Centennial Exhibition," etc.

I fear that Mr. Stowell has confused the idea of a motor transformer with the use of a dynamo run as a motor; he will doubtless remember that the armature of the "Telemachon" machine possessed two sets of coils and two commutators; and while in my article I described at length experiments made with this machine, in which it was used as a motor both during the Centennial Exhibiton in 1876, and at Ansonia, Conn., where Professor George F. Barker, Mr. F. J. Sprague, and others, saw the experiments made with it in transmitting power, I remarked "that I believed it had never occurred to any one to try it as a motor-transformer, which one would think would naturally have suggested itself." By this, I meant, of course, that the current from the dynamo should be sent through one set of coils causing it to run as a motor and allowing the second set of coils to generate electricity as a dynamo.

For a considerable time past I have on various occasions called attention to the promising field which the direct current transformer or motor transformer represented, and as this machine was constructed in November, 1875, and possessed the essential qualifications of a motor transformer, it seems strange to me that such an experiment had not been tried with it at that time.

The incident which Mr. Stowell refers to of the test which occurred at the Centennial Exhibition is an interesting one, and while I have gone to a very great deal of pains to secure as full information of Mr. Wallace's work as possible, I am well aware that there are many items of interest such as Mr. Stowell refers to and which would be interesting in this connection, and I should be pleased to receive any additional matter or any corrections of any statements which I have made, provided they are substantiated. Mr. Stowell states that the first exhibit in which Wallace & Sons ran arc lamps in series in public was at Boston in 1878. I have been informed by Mr. Wallace and his assistants, and by Prof. Barker and others, that he had lamps running in series at the Ansonia Works for a considerable time prior to this and that the first plant in which the lamps were run in series was placed in the American Institute Fair in New York city, which was followed shortly thereafter by the plant placed in the Mechanics' Institute Fair in Boston. Mr. Brush made an exhibit at the same time, but did not run his lamps in series until after they had been operated in public by Wallace, and quite some time after they had been in operation in the works of Wallace & Sons at Ansonia.

I heartily endorse Mr. Stowell's statement of the splendid grit and courage which Mr. Wallace showed in the costly exhibitions which he made in various parts of the country, and in the construction of the immense plant for the manufacture of the steel-cored copper wire which I described in my article and which subsequently became the property of the Postal Telegraph Company.

I fear, however, that Mr. Stowell is in error in stating the great advantages which would have accrued to the public had the telegraphic system throughout the country been equipped in the manner at that time proposed. The results shown by the construction of the circuits to Chicago, St. Louis, Philadelphia and Washington, in which the Postal Telegraph service was equipped with the steel-cored copper wire for Gray's system of harmonic telegraph showed great mechanical difficulties and the cost of construction was enormous, and as stated in my article, the introduction by Wallace & Sons of hard-drawn copper wire possessing not only the necessary tensile strength, but high conductivity, obviated the necessity of using the more expensive and mechanically less efficient steel-cored copper wire, and this like many another question, became simply one of the "survival of the fittest." The construction of this plant was nevertheless one of the most remarkable undertakings in which electricity has been applied, which this country has ever seen.

In conclusion I wish to state that I hope I shall always be willing to correct any statements of mine which are calculated to convey an erroneous impression; and in view of the importance of the subject which I was handling in my Wallace article, I took all possible pains to secure the facts, and not only did I study carefully the scant records of Mr. Wallace's work in the electrical literature, but visited many times the works of Wallace & Sons at Ansonia, interviewing both William and Thomas Wallace, William Wallace, Jr., and the various assistants who had been identified with Mr. Wallace's work, and examining the shop records which showed specifications and dates of construction of the machines and records of tests; and among others whom I have called upon to secure information, some of whom have placed at my disposal their note books and diaries, are the following: Prof. George F. Barker, of the University of Pennsylvania; Prof. Trowbridge, of Harvard; Profs. C. F. Chandler and L. H. Laudy, of Columbia, and Thomas A. Edison, Hiram S. Maxim, F. J. Sprague, Mrs. Dr. Henry Draper, Henry Edmunds, and the officers of the Postal Telegraph Company, and others.

Wm. J. Hammer.

New York City, March 31, 1893.

DYNAMO OR GENERATOR?

This being a year devoted to congresses for standardizing things in general, I venture to bring forward a rather curious use of terms which has not, to my knowledge, been touched upon in print.

The point in question is the almost universal use, commercially, of the word *dynamo* for electric lighting and *generator* for electric power transmission. It would be interesting to know whether this distinction comes from some high authority or is the result of a "long-felt want" for a greater variety of technical terms. In the numerous cases where both lights and motors are supplied from the same machine what are we to call the machine?

Then there are all the machines for converting mechanical into electrical energy for other purposes than lighting and running motors which would seem to be unjustly left out in the cold.

The word dynamo is an old friend and has the merit of not having been used for more than one purpose. Why not adhere to it and let the generator go where so many of our English friends are trying to send "that blessed word installation?"

F. V. Henshaw.

New York City.

SUN SPOTS AND MAGNETIC STORMS.

In an article in your last issue entitled "Earth Currents" contributed by Mr. Wm. Finn, reference is made to the opinion of Lord Kelvin that "the supposed connection between magnetic storms and sun spots is unreal and that the seeming agreement between the periods has been a mere coincidence."

Lord Kelvin is a very wise man and a very eminent authority, but I fear that his dictum will not be accepted by that large and also eminent class who believe that there is a connection between the two that is more than the coincidence of disassociation. As long as there is an absence of connecting proof, Lord Kelvin's utterances are like all other men's in the realms of speculation. What would seem to give great force to his negation is the statement that "the work which must be done at the sun to produce a terrestrial magnetic storm" (citing the magnetic storm of June 25, 1885,) during the eight hours of that disturbance, would equal four months of his (the sun's) regular heat and light.

Now following out the same line of reasoning let me inquire how much work the sun would have to do to burn a bit of paper that is quickly ignited under a small burning glass? It is seen that by the interposition of a third agency, to us all at present unknown, the effect of moderate potential is tremendously enhanced. So with magnetic storms; an agency unknown but existant, increases the inductive earth charge, it may be, or else distorts the normal inductive charge, so as to create zones of unequal potential, in which latter case earth currents are supposed to be Foucault or parasitic currents, just as they occur in an ordinary armature; so they traverse the globe and produce disturbing effects.

It may be long before we are allowed to call our sun a generator, acting in an electrostatic field, which field includes our earth, but when such a time is ushered in, we can then rationally proceed to connect solar-disturbances with earth magnetic storms, with a greater certainty of success. We know that there is such a thing as electro-magnetic induction, that the disruptive discharge produces a whole category of as yet unexplained phenomena—the electric spark not only changes values of normal induction but also complete polarities—and under these circumstances it may not be improbable that solar-eruptions are accompanied with disruptive discharges far-reaching in inductive effect.

M. W. Hassan.

Rochester, N. Y.

Literature.

The Voltaic Cell. By Park Benjamin, LL. B., Ph. D. *New York*, John Wiley & Sons, 1893. 200 illustrations. 6 by 9. 562 pages. Price $5.00.

Notwithstanding the widespread use and infinite variety and form which have been given to the voltaic cell, it is a fact that but few good works on this subject in English are available. This may appear to be a matter of small moment to many, in these days of heavy electrical engineering, but the voltaic cell still has a legitimate and important work to perform, and who shall say that it may not, in the future, develop so as to occupy a sphere of much larger usefulness.

Dr. Benjamin has collected an admirable amount of information on the subject, and coördinated it in a manner which will enable the student to gain a thorough knowledge of all the more important work that has been done in this field. The book will also serve as a handy work of reference for the practical worker and expert.

Dr. Benjamin's opening chapter will be read with more than ordinary interest, and will serve to clear away the vague notions now current as to whom is due the honor of the discovery of the voltaic cell. In his chapter of definitions, he has sought to unravel the hopeless tangle into which writers have plunged electrical readers in the indiscriminate and indefinite use of the terms "element," "couple," "battery," "electrode," "pole," etc., and has brought much astute reasoning to bear on the validity and propriety of the terms which he himself favors.

It would take us too long to discuss in detail the immense ground covered in this work, and it must suffice to say that it describes in detail all the primary and secondary batteries which have thus far been employed in practice, or suggested, together with many practical points on their use. We also find valuable chapters on heat, light and gas cells.

Not the least valuable addition to the work is the chapter on the "Bibliography of the Voltaic Cell," which contains a most complete list of books and papers treating of the subject, some of which have been largely drawn upon by the author, as, for instance, Tommasi's work.

It is to be regretted that a work of such general excellence as this should suffer from bad proof-reading.

Bericht über die Verhandlungen des Internationalen Elektrotechniker-Congresses zu Frankfurt a. M. September, 1891. Part 2. *Frankfurt a. M.*, Johannes Alt, 1892. 395 pages. 7½ by 11. Price $4.80.

This part of the proceedings of the Electrical Congress held at Frankfurt a. M., in September, 1891, contains the reports of the sections on: I. Theory and Measurements. II. Heavy Current Technics. III. Signals, Telegraphy and Telephony. IV. Electro-chemistry and Special Applications of the Electric Current. V. Electrical Legislation.

Section II, on the Heavy Current Technics contains much of interest on the subject of alternate current motors, and much discussion on the advantages and disadvantrges of two-phase and single-phase motors.

The Electric Railway in Theory and Practice. By O. T. Crosby and Dr. Louis Bell. Second edition enlarged and revised. *New York*, 1893. The W. J. Johnston Company, Ltd. 416 pages, 182 illustrations. Price, $2.50.

In the second edition of Crosby & Bell, a great part of Chapter I has been rewritten and minor corrections and additions made in the other chapters. Two appendices have been added, "Motors with Bevel Gear and Series Multiple Control of Motors" and "Method of Measuring Insulation Resistance of Overhead Lines." The index has been carefully revised and considerably extended by additions from the index notes of a well known street railway engineer.

Tips to Inventors. Telling what inventions are needed, and how to perfect and develop new ideas in any lines. By Robert Grimshaw, Ph. D., M. E. *New York*: 1893. The Practical Publishing Co. 84 pages. 5 x 7 inches. Cloth. Price, $1.

The title of this work is sufficiently explanatory of its contents. Suffice it to say, that the author has prepared a number of most entertaining chapters on the work which now lies before the engineer, the chemist and the electrician, and which will well repay perusal.

MARSHALL'S PORTABLE COMBINED CONDENSER AND HIGH RESISTANCE SET.

We have already had occasion to describe the very interesting and valuable arrangement of standard condensers introduced by Mr. Wm. Marshall, of this city, and are once more enabled to note a new application of this type of instrument which has come to be recognized as the condenser *par excellence.*

Heretofore, in testing out or locating faults in underground electric light, telegraph and telephone cables it has been necessary for the electrician to carry a condenser and a high resistance in separate boxes and he was thus considerably encumbered. Besides this, in connecting up the instruments for testing, the wires leading from these boxes to key and galvanometer presented quite a tangle and frequently led to mishaps. With these difficulties in mind Mr. Marshall hit upon the clever idea of combining the standard condenser and high resistance in a single box with the result of producing the combination sets shown in the accompanying engravings.

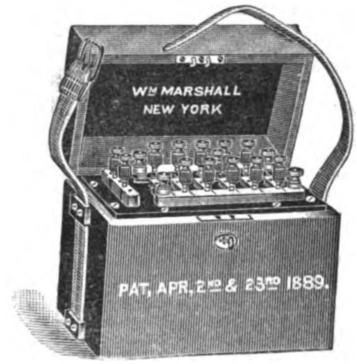

Fig. 1.—Marshall's Portable Combined Condenser and High Resistance Set.

In these, Fig. 1 shows the portable combined $\frac{1}{2}$ microfarad standard condenser and 100,000 ohms resistance. As will be noted, the condenser is of the Marshall multiple series type divided into five sections of $\frac{1}{10}$ microfarad each. By using the multiple series arrangement each section of the condenser can, if desired, be used independently of the other and a wide range and gradation of capacities can be obtained. To facilitate this, each plug is provided with a binding post to which the wires leading to the discharge key and galvanometer can be attached. The high resistance set is divided into two coils of 50,000 ohms each and is likewise provided with plugs with binding posts. Each plug has a hole provided for its reception when not in use so that there is no likelihood of its being laid aside and going astray.

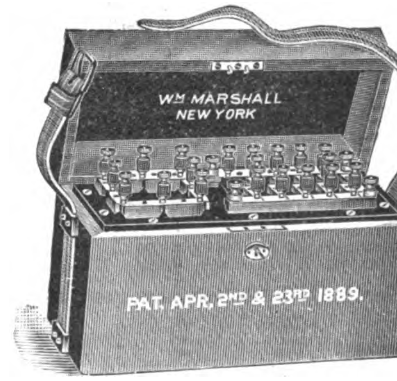

Fig. 2.—Marshall's Portable Combined Condenser and High Resistance Set.

The set shown in Fig. 2 resembles that just described except that the high resistance coil is divided into four sections, respectively of 10,000, 20,000, 30,000 and 40,000 ohms each.

These portable sets are constructed with the usual care bestowed upon all of Mr. Marshall's work and will without doubt meet with the same favor that has been accorded to his instruments in the past.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED MARCH 21, 1893.

Accumulators :—

Secondary Battery. L. Bristol. London, Eng., 493,817. Filed Aug. 28, 1890.

Employs a plate composed of an active agent and a fibrous binding material, conductors embedded there in and having anchoring points or projections.

Secondary Battery Electrode. W. W. Donaldson & R. Macrae, Baltimore, Md., 494,062. Filed March 4, 1892.

Claim 1 follows:

A battery plate section made up of a diaphragm, a cup and interposed filling of active material, the diaphragm being imperforate and the cup and filling perforated.

Alarms and Signals :—

Electric Railway Signal, H. V. Miller, Bloomington, and A. C. Miller, Aurora, Ill., 493,935. Filed Nov. 8, 1892.

An automatic electric block system for steam railways.

Block Signal System, J. La Burt, New York, N. Y., 494,007. Filed June 16, 1892.

A system for automatically shutting off the steam from an engine and consequently stopping the train at the beginning of a block.

Railway Block Signal, R. D. Peters, Winamac, Ind., 494,077. Filed July 11, 1892.

An electric block system for steam railways by means of which the engineman of a train entering a block is not only informed of the presence of another train within the block, but can also see the direction in which the other train is moving and its location.

Electrical Railway Signal, S. W. & A. C. Miller, Aurora, Ill., and H. V. Miller, Bloomington, Ill., 494,111. Filed April 4, 1892.

An automatic electric danger signal for steam railways.

Distribution :—

Electric Lighting System, S. W. Rushmore, Brooklyn, N. Y., 493,842. Filed Febr. 7, 1892.

Claim 5 follows:

A combination of two or more electrical generators, means controlled by the current for connecting the generators successively in series, a circuit of translating devices supplied in series thereby, and constant potential circuits supplied by individual generators of the series. (See THE ELECTRICAL ENGINEER, March 29, 1893.)

Dynamos and Motors :—

Dynamo Electric Machine, S. Hellebrandt Przemysl, Austria Hungary, 493,718. Filed May 25. 1892.

A small portable dynamo operated by a spring motor and the whole enclosed in a common case.

Dynamo Electric Machines, F. Bain, Chicago, Ill., 493,745. Filed Dec. 21, 1891.

Claim 1 follows:

An armature frame for dynamo electric machines consisting of a supporting shaft and a series of primarily dish-shaped plates on such shaft, and flattened thereon to cause them to grip the shaft.

System of Winding Armatures for Dynamo Electric Machines, W. M. Thomas, Grand Rapids, Mich., 494,042. Filed Jan. 29, 1892.

Invention consists in winding all wires constituting each coil simultaneously side by side like longitudinal threads in a ribbon and filling the area of the divisions of the armature of each winding.

Lamps and Appurtenances :—

Thermal Cut-Out for Electric Lamps. H. Lemp & M. J. Wightman, Hartford, Conn., 493,629. Filed Aug. 27, 1886.

A thermostatic shunting contact located on the leading-in wires within the lamp and adapted to be brought into contact by the heat of the arc formed on the rupture of the filament.

Electric Arc Lamp, E. Thomson, Lynn, Mass., 493,739. Filed June 30, 1886.

Invention consist of means for imparting first a lifting movement to the carbon for the purpose of forming the arc and then by the same mechanism producing an intermittent step by step feed movement each of whose steps may be of any desired length.

Miscellaneous :—

Dental Appliance for Obtunding Nerves, W. P. Horton, Jr., Cleveland, O., 493,723. Filed Aug. 18, 1892.

Electric Clock Striking Mechanism, W. Kaisling, Alleghany, Pa., 493,777. Filed April 4, 1892.

Apparatus for Purifying Liquors by Electrolysis, J. Becker, Kymulga, Ala., 493,809. Filed March 12, 1892.

Transmission of Power, T. A. Edison, Llewellyn Park, N. J., 493,858. Filed Aug. 28, 1890.

Consists of a pulley made magnetic by a suitable winding and a belt composed of thin steel strips riveted together.

Insulating Coupling, E. B llet, Bordeaux, France, 493,883. Filed Oct. 31, 1892.

Electrical Attachment for Rocking Chairs, C. E. Hartelius, Bay Ridge, N. Y., 493,997. Filed Nov. 22, 1892.

Reciprocating Electric Drill, W. O'C. G. Birkin, Nottingham, England, 494,053. Filed April 23, 1892.

Consists of a drill actuated through a solenoid, in which provision is made to impart a slightly rotary movement to the tool.

Electric Cigar Lighter, W. M. Thomas, Chicago, Ill., 494,091. Filed Oct. 26, 1892.

Electrical Appliance, C. H. Folger, Cincinnati, Ohio, 494,098. Filed Sept. 5, 1892.

A reciprocating electric motor adapted for ringing bells, etc.

Switches and Cut-Outs :—

Automatic Electrc Cut-Out, F. B. Badt, Chicago, Ill., 493,672. Filed June 6, 1889.

Employs a high resistance electrical magnetic circuit-closing device adapted to be operated when the battery is fully charged, a circuit controller and mechanism adapted to open the circuit of the storage battery and dynamo and to close an engine valve.

Electric Connector and Cut-Out, C. H. Crockett and C. C. Allen, Boston, Mass., 493,754. Filed Apr. 8, 1892.

Employs a removable cap having wire clamps for receiving the terminals of the supplied branch and affording them connection through fuse wires to the main conductor connected with the base portion.

Electric Cut-Out, C. H. Crockett and C. Allen, Boston, Mass., 493,755. Filed Apr. 8, 1892.

Similar in its object to 493,754.

Switch for Electric Light Fixtures, J. Hutchinson, New York, N. Y., 493,868. Filed Apr. 8, 1892.

A switch adapted to be readily attached to the outside of an ordinary tubular arm without the necessity of a special section for its reception.

Rosette Cut-Out, C. E. Barry, New York, N. Y., 493,884. Filed Aug. 16, 1892.

Employs a cap connected with the base by a bayonet joint and having several pairs of contacts provided with fuses connected with the lamp wires and adapted to be brought successively into circuit.

Lightning Arrester, H. O. Henneberg, Berlin, Germany, 493,926. Filed Dec. 9, 1892.

Claim 3 follows:

In a lightning arrester for electric conductors, the combination of a discharge plate and an inner cover relatively separated, and an outer cover having a depending rim provided with an inner closing rib.

Railways and Appliances :—

Electric Railway Signal. J. Bradford & J. P. Williams, Boston Station, Ky., 493,678. Filed June 23, 1892.

Claim:

The combination with the track rails of the transverse roads connected to the rails and beneath the same and formed with oppositely extended hooped extensions. insulators on the horizontal portions of said extensions and the two line wires on said insulators.

Conduit Electric Railway, H. P. Feltrow, Columbus, O., 493,695. Filed March 4, 1891.

Employs a flexible conductor supported in the conduit on insulated brackets and adapted to be lifted out of the slot and supported upon a trolley wheel above the surface of the ground.

Insulator for Trolley Wires. M H. Hathaway, Springfield, Mass., and J. Kelleher, Manchester. N. H.,—A. L. Hathaway Administratix to M. H. Hathaway, deceased, 493,713. Filed April 2, 1892.

Consists of a cup shaped shell suspended from a bracket arm and having a lining of insulating material entirely surrounding a metallic tube extending upwardly within the shell; a metallic stem entering the tube and having at its lower end a trolley wire clamp, and means for securing the stem within the tube.

Conduit System for Electric Railways, E. Hazelton, Lansing, Mich., 493,716. Filed Feb. 15, 1892.

A conduit system in which contact is made with the conductor through casings in the wall of the conduit, the lines being insulated except at the point of contact.

Trolley for Electric Railways, J. F. Saitz, Bald win, Pa., 493,789. Filed June 18, 1891.

Employs a trolley frame carrying two wheels adapted to make contact with the upper side of the trolley wire and having a balancing weight suspended from their common centre of gravity.

Electrically Operated Railway Switch, P. Evans, Philadelphia, Pa., 493,918. Filed Dec. 7, 1891.

A steam railway track switch automatically actuated by means of an electric contact carried by a moving train.

Electric Locomotive, A. Philipsborn, Berlin, Germany, 493,942. Filed April 21, 1892.

Relates to means for concentrating the motor and gearing about the car axle and also establishing elastic connection between the motor and the car.

Electric Locomotive, A. Philipsborn, Berlin, Germany, 493,943, Filed May 17, 1892.

Provides means for the elastic suspension of the motor between the trucks.

Electric Car, C. Brown, Basle, Switzerland, 493.969. Filed Mar. 8, 1892.

Employs a driving wheel provided with an outer rim made separate from the body of the wheel, a motor for actuating it and the revolving parts attached to the body of the wheel, and a spring interposed between the outer part and the body.

Marine Railway, E. Kaye, Phillipsburg, Pa., 494,066. Filed Dec. 9, 1892.

An arrangement whereby a vessel is propelled by power applied to a submarine carriage connected to the vessel and running on tracks arranged on the bottom of the stream.

Telegraph :—

System for Transmitting Electric Currents, E. Baines, Brooklyn, N. Y., 493,673. Filed Mar. 21, 1892.

Employs two or more non-insulated line wires connected to earth, each supplied with a generator and transmitting and receiving instruments; all the line wires being connected with a common insulated metallic return conductor.

Telephones and Apparatus :—

Listening and Ringing Key for Telephone Switchboards, W. M. Goodridge, Highland Park, Ill., 493,704. Filed July 19, 1890.

Employs a flat metallic spring lever and two other metallic springs each forming the terminal of a plug. Above these terminal springs are push buttons whereby the springs may be forced away from contact with the heel of the main spring lever which is adapted to connect the operator's telephone.

Telephone, T. Bloomer, New York, N. Y., 493,907. Filed Nov. 28, 1892.

Claim 1 follows:

In a signal box a movable rod in combination with a transmitter suitably supported, and a hook to support the receiver, and circuit contacts, the transmitter, receiver, hook and contact all positioned by the movement of the rod.

THE STANDARD ELECTRIC SIGNAL COMPANY.

THE STANDARD ELECTRIC SIGNAL COMPANY has just elected as one of its directors, Mr. John Dennis, Jr., of the Rochester *Democrat and Chronicle*. Mr. Dennis has for 13 years been connected with that paper, and for the past three years has been its efficient Telegraph Editor. Travelers who have to sojourn from time to time in the cities of the western part of this State—Syracuse, Rochester and Buffalo—have come to appreciate the telegraph page of the *Democrat and Chronicle* as being about the next thing to a New York paper. During Mr. Dennis' connection with the *Democrat and Chronicle* he has found time to take up the subject of electrical engineering, until now, with the possible exception of the electrician of the company himself, Mr. Dennis is better informed on the working of the apparatus in the Standard Electric Signal Company than any one else. The last-named company is now installing in Rochester a large automatic fire alarm plant which the Standard Electric Signal Company propose to make the finest thing of the kind in this country. THE ELECTRICAL ENGINEER wishes Mr. Dennis and his company the fullest measure of success.

PERSONAL.

J. W. PARKER.

J. W. Parker.

Mr. J. W. Parker, the subject of this sketch, is the Philadelphia representative of the Ball Engine Co., of Erie, Pa., and owner of the business of J. W. Parker & Co., in that city. Mr. Parker is a Southern man, coming from the extreme south end of Louisiana, and he has been in Philadelphia 12 years. His first business was that of telegraphy, at which he worked four years prior to coming north. Like many other Southern young men of good family who lost their all through the war, he was poor but ambitious, and when the first telegraph lines were put through the section of country in which he lived, he made the acquaintance of the operator, and in exchange for instructions gave his labor in the handling of freight in the railroad office, delivery of messages, etc. His first promotion came through the superintendent's notice being attracted to a little electric motor he had made and was surreptitiously running on the telegraph batteries one night after working hours. For four years he remained a regular operator on the road.

A natural aptitude for mechanics made him the acquaintance and afterwards the apprentice of a mechanical engineer traveling in the south, and when he left home it was with the express determination of learning mechanical and electrical engineering. Good fortune gave him the friendship of Mr. H. L. Lufkin, of New York, well known in electrical circles, and of Mr. Jas. McBrier, of Erie, and to these gentlemen he attributes much of his success. Mr. Parker became the selling agent for the C. & C. Electric Motor Co., and for the Ball Engine Co., of Erie, and then branched out on his own account. To-day he controls one of the best engineering and construction houses operating in the east. His connection with the motor company long since ceased, the demands upon his time by mechanical engineering making it impossible to give the electrical branch its proper attention. He has surrounded himself with a most efficient force of assistants, in draughtsmen, consulting engineer, superintendent of outside construction, master mechanics and others; and these men give their entire time to the designing of modern electric power steam plants for railroading, lighting and mining. Some of the finest plants in Pennsylvania and neighboring States are the result of their work, and at present some of the largest plants going up in the State were contracted for and are being built by Mr. Parker and his assistants, notably the large plant of the Blakley & Dickson Traction Street Railway at Scranton, Pa.

CAPT. A. DE KHOTINSKY.

Owing to the winding-up of the affairs of the Germania Electric Company, of Boston, all the electrical and mechanical devices, patents, and other rights relating to the manufacture of filaments, incandescent lamps, accumulators, etc., owned by the company have reverted to Capt. A. de Khotinsky, mechanical and electrical engineer of the company, the original owner. Capt. A. de Khotinsky being now released, is prepared to enter into business negotiations with parties desiring to avail themselves of these patents and processes; and his large experience in these various branches ought to make his services of great value to any one seeking for an expert in the manufacture of lamps and storage batteries.

MR. F. A. SCHEFFLER.

As we have already mentioned, Mr. Frederick A. Scheffler has resigned as the superintendent of Brush Electric Company's shops at Cleveland. On the last day of Mr. Scheffler's stay he was presented by the foremen of the various departments, with a gold locket ornamented with diamonds, and a pair of cuff buttons, accompanied by a set of resolutions expressing the regret of the men at Mr. Scheffler's departure. Such tributes are rare indeed, and speak well for the popularity of Mr. Scheffler among those who were brought into close contact with him.

MR. C. W. PHIPPS.

Mr. Charles W. Phipps, who has grown up in the factory of the Brush Electric Company, where he started in 1880 as a boy, and who has represented the Brush Company in construction work in England, on the continent of Europe, in China and Japan, and in the Eastern portion of this country, with headquarters in New York, has recently been appointed superintendent of the Brush Company.

Mr. Phipps is noted for his energy and push, his thorough knowledge of Brush apparatus, and his ability as an engineer. He is a man who is very popular with all those who have come in contact with him. At the peril of his own life he once rescued a number of sailors in the bay at Yokohama, Japan. His action in climbing the arc light post at the corner of Sixth avenue and Thirty-third street, New York City, during a storm, and, in the presence of several thousand people, rescuing a lineman of the United States Electric Illuminating Company, was heroic and gave him the deserved reputation of being a very brave man.

Mr. Charles W. Black, a graduate of Princeton and one of Prof. C. F. Brackett's most promising pupils, has been appointed Assistant Superintendent of the Brush Electric Co.'s factory. Mr. Black, after leaving Princeton, secured a position in the Brush factory, and with hard work combined with his knowledge and ability, has secured just promotion.

Mr. E. J. Hamilton, father of B. F. Hamilton, of the Sawyer Man Electric Co. died on Easter Sunday. He had been 45 years a member of Olive Branch Lodge, I. O. O. F., etc., and was a highly respected member.

Mr. H. W. Hamblin has been appointed superintendent of the Green Island Electric Light Co., Green Island, Albany County, N.Y.

THE MUNICIPAL ELECTRIC LIGHT PLANT AT PEABODY, MASS.

A report of the Peabody electric light committee has been issued. The report includes the first four months of the system's working. The total cost of the plant to date has been $48,176.92. There are four dynamos, each having a capacity of 48 1,200 c. p. lamps, or the equivalent in incandescents.

There are now 149 arc lights in use, with 40 miles of wire, lighting 23 miles of street. The report states:

In our opinion the town is as well, if not better lighted than any place we have visited. We investigated quite thoroughly the matter of incandescent lamps for street lighting, and concluded that the arc service was the only one that gave complete satisfaction for money expended.

We find the average cost for each 1,200 c. p. arc lamp from Oct. 1, 1892, to Feb. 1, 1893, including taxes, is $2\frac{16}{100}$ cents per hour, and for the year the cost per lamp will be $68.72 instead of $75, as reported to you by this committee in our estimate, the lamps to burn from one-half hour after sunset until one hour before sunrise every night in the year except at the full of the moon. The number of hours for each lamp during such a run will be about 3,188. The town has the means and can furnish with hardly any extra cost, for commercial lighting, arc or series incandescent lamps.

In the cost of running expenses, the interest on $50,000 at 4 per cent. is added, and also a depreciation of 5 per cent. on $30,000, taxes on $85,000 at $15 on a thousand, insurance at $195, and every other possible item that can in any way be denominated a part of running expenses.

A LARGE GOULDS ELECTRIC PUMPING PLANT.

At Portland, Ore., there are probably in use more electro-hydraulic pumping plants than in any other city in the country. Among the more notable is one at the Oregonian Building, installed by The Goulds Manufacturing Company, of Seneca Falls, N. Y. In the said building, one 10 x 12-inch triplex-power pump operates two large passenger elevators, two sidewalk lifts and one freight elevator. The pump discharges into a 3,000-gallon pressure tank maintaining a uniform pressure of 100 pounds per square inch. The motive power is a 75 h. p. Edison motor, which, in addition to running the 10 x 12-inch triplex-power pumps, operates a large Hoe printing outfit. The discharge to the pressure tank is automatically regulated by means of a by-pass valve, which is made to shift the water from pressure tank to open tank as the pressure reaches its normal amount. The plant is in operation 24 hours per day, and the elevators and other machinery are in constant motion. It has been pre-eminently successful, the consumption of power of the daily running coming within the prescribed limit and guarantee of the expectations of the engineers.

REPORTS OF COMPANIES.

FIRST ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY.

BELOW is the full text of the first annual report of the General Electric Co., presented at Schenectady to the stockholders on April 11, by President C. A. Coffin. The directors of the Company are: F. L. Ames, C. A. Coffin, T. J. Coolidge, Jr., C. H. Coster, T. A. Edison, Eugene Griffin, F. S. Hastings, H. L. Higginson, D. O. Mills, J. Pierpont Morgan and H. McK. Twombly.

The General Electric Company was incorporated April 15th, 1892, and began active business on the first day of June, 1892; so that the report presented by your Directors, at this meeting of stockholders, covers a period of eight months ending January 31st, 1893.

As you know, the General Electric Company acquired in exchange for its stock practically all the capital stock of the Edison General Electric Company, of the Thomson-Houston Electric Company, and of the Thomson-Houston International Electric Company. These three corporations, referred to hereafter in this report as the underlying companies, still retain their independent corporate existence. The first two continue their manufacturing business as before, the General Electric Company purchasing and distributing the chief part of the apparatus manufactured by them. The various selling and many other departments of the Edison General and Thomson-Houston companies have been gradually merged into corresponding organizations of your Company.

The difficulties inherent in such a reorganization were many and serious, and we feel that the stockholders are to be congratulated that, largely because of the zeal and hearty co-operation of the former officers and employés of the Edison General and Thomson-Houston Companies, it has been carried through to a complete and successful issue.

LOCAL LIGHTING AND RAILWAY COMPANIES.

While your Company has about 6,000 customers included in the different departments of its business, the interesting and important development is in the direction of local lighting and railway enterprises.

The following information, with respect to local illuminating and electric street railway companies using your apparatus, will be of interest to the stockholders.

LIGHTING COMPANIES.

The total number of such central station companies using Edison and Thomson-Houston apparatus is 1,277, supplying about 2,500,000 incandescent and about 110,000 arc lamps.

The growth of these companies has been phenomenal, and it is very satisfactory to note that those which have been established longest are making the most rapid increase in size of plant and volume of business.

During the past year there has been a very marked appreciation in the value of the securities of local companies, especially in the larger cities, testifying to the increased confidence of investors in such properties.

RAILWAY COMPANIES.

	Feb. 1, 1891	1892	1893
Total number of roads operating and under contract................	151	214	435
Total number of cars in actual operation..........................	1,578	2,790	3,386
Number of miles of road in actual operation.....................	1,252	2,315	4,927

During the past eight months there has been a notable increase in the size of individual machines manufactured at the different factories, as well as a large increase in the total factory output.

On February 1st, 1892, the largest power-generator manufactured was of 275 h. p. Machines of 2,000 h. p. each are now being manufactured by your company, seven of which are already sold for early delivery. The largest lighting generators in use February 1st, 1892, were capable of supplying only 2,000 incandescent lights each. There are now being constructed generators of the direct-coupled type with a capacity of 12,000 incandescent lights each. Many local lighting stations are being equipped with steam engines directly coupled to such machines, giving a capacity of about 25,000 incandescent lights from each engine.

Of the largest direct-coupled lighting generators which were manufactured a year ago, there were shipped during the year 1892 an aggregate of 7,000 h. p. Of such sizes now being constructed there are at present on order 8,000 h. p.

Machines for power purposes (principally railway) aggregating 40,000 h. p., have been shipped during the past year. There are now being manufactured, on order, generators aggregating 37,000 h. p., or practically as much as the total shipments for the past year.

Most satisfactory progress has been made in the development of apparatus for mining purposes, particularly of locomotives for haulage work in coal mines. Thirty of such locomotives, with a very large amount of other mining material, are now under construction at the works.

The efforts of many of your best engineers have been directed for some time to the production of electric locomotives for which we now have numerous orders for haulage and general railway purposes. Two locomotives of 1,600 h. p. each, ordered by one of the principal trunk lines, are now under construction and nearly ready for use. The equipment of the elevated electric railway at the World's Fair, six miles in length, and which is now nearly completed, is being supplied from the Schenectady factory, and it is hoped will be in operation at the opening of the Fair.

LICENSEES.

The relations between your company and its various licensees, and between it and those of the underlying companies, are of the most satisfactory character. Your directors appreciate that the interests of the company are closely connected with the welfare of its licensees, and there is a corresponding recognition on the licensees' part that the cordial co-operation of your company is essential to the fullest development of their business.

No effort will be spared to secure from the recent patent decisions in your favor the greatest possible benefit to these licencees. The public, through them, will be distinctly benefited, because of the concentration of local illuminating and power business in the licensed central stations equipped for supplying light and power at minimum rates.

The prices at which apparatus and lamps are now furnished by the General Electric Company, for use of such stations, are in many instances lower than those which prevailed prior to sustaining the lamp patent, while the quality and efficiency of the apparatus are largely increased. Thus the licensees are enabled to cheapen their production and their prosperity is greatly enhanced —a prosperity in which your Company has a direct and permanent share.

PATENTS.

The patent situation is encouraging and promising. The decision of the highest Court sustaining the fundamental incandescent lamp patent, which decision has been followed by many other tribunals, has vested in your Company the right to the incandescent lamp business of the United States, a result of great value to the Company.

The strenuous efforts made by your competitors to develop an incandescent lamp which will not infringe this patent have been thus far wholly without success, and there is no reason to believe that any different results will be achieved in the future.

The decisions heretofore rendered in favor of the Thomson-Houston and Brush companies, covering the double carbon arc lamp, automatic current regulation and electric storage are of very great value to your Company.

Although it is well known that the patented inventions of Edison, Thomson, Brush, Van Depoele, Rice, Sprague, Bentley, Knight, and other inventors now or heretofore connected with your organization are the basis of substantially the entire arts of electric lighting, electric railways and electric motive power now in general use, the situation up to the date of the organization of the General Electric Company was not favorable to the best development of business under these inventions.

Suits against infringers are now in active progress on many important patents, other than those already sustained by the Courts, covering essential features in electric railway, lighting, and power apparatus. These suits will be pushed as vigorously as possible.

In dealing with the numerous past infringers, your Directors are of the opinion that the substantial interests of the shareholders can be protected without a harsh or offensive exercise of your rights, and in such way as to greatly benefit the Company and to satisfy consumers and the public of its desire to act in an entirely fair and liberal spirit.

FINANCIAL.

There are annexed to this report the Company's condensed balance sheet and statement of profit and loss as of January 31st, 1893, showing that in the eight months during which your Company has been in operation its profits amount to $1,024,954.59 in excess of three quarterly dividends on the common and one semi-annual dividend on the preferred stock.

In order that the stockholders may understand the position of the Company, the following explanation as to the general character of the items in the balance sheet is submitted.

INVESTMENT ACCOUNTS.

Under this head will be found the assets now represented by the stocks of the three underlying companies, substantially all of which have been acquired by your Company.

Details in regard to these companies will be found from which it will be noticed that the basis upon which they were acquired by your Company represents a cost of about $8,000,000 for all their patents, other valuable rights, licenses and other contracts. This is after writing down the assets they still own—manufacturing plants, factory inventories, etc.—to conservative valuations.

The transactions of your Company are to a considerable degree with local companies working under contracts licensing them to use the patents, about two thousand in number, under which your Company operates. Your Company is now supplying apparatus to about thirteen hundred local companies, the royalties from which run from $1,500,000 to $2,000,000 per year. It is believed that the royalties will be greatly increased in the future, so that $8,000,000 would appear to be far within the actual value of the patents, contracts, etc., which are represented thereby.

Your Company has to a large degree acquired the business, other than manufacturing, of the Thomson-Houston and Edison General Companies, and has liquidated a large part of their liabilities. This course will be continued during the present year.

The preferred stock of the United Electric Securities Company has been sold since the close of the fiscal year at a price in excess of the value at which it appears in the balance sheet. The common stock of the same company—$825,500 out of a total issue of $1,000,000—is taken in the balance sheet at par. The company is making large profits and paying regular quarterly dividends.

The stock of the Canadian General Electric Company, a manufacturing and selling company controlling the Edison and Thomson-Houston patents in Canada, is taken at par. Its sale at an early date is expected, it being now under option to a Canadian syndicate at above par.

The stocks of the Fort Wayne Electric Company and Northwest General Electric Company are paying eight per cent. dividends on the value at which they stand in the balance sheet.

Stocks of "Miscellaneous Companies" carried at $71,566, comprise holdings in various corporations not considered local or licensee companies.

OTHER ASSETS.

With reference to these items it may be stated that in the judgment of your Board they are taken at safe figures. They consist of stocks, bonds, cash, notes and accounts receivable, merchandise on hand and work in progress; and it will be noticed that they amount to $29,559,600.61 as against total current liabilities of $5,246,219.

The stocks of local companies, which appear in the balance sheet at $5,772,622.80 (par $11,362,011.65) have been valued carefully with the intent to carry them at a figure which can easily be obtained for them.* As a further margin in this respect, stocks amounting at par to $1,801,940 (most of which accrued to this Company under license contracts with recently organized companies) are taken in the balance sheet at the nominal value of $1.00 for each block, although there is reason to believe that within a moderate time these will develop a substantial earning capacity.

The bonds are almost entirely those of local companies. They are nearly all first mortgage bonds, payable in gold, and stand in the balance sheet at about seventy per cent. of their face value. All of these bonds excepting $459,000 at par value—$251,088.07 book value—are regularly paying their interest, and the comparatively small amount in default is carried at prices lower than it is believed will be realized.

Some of the bonds carried in the balance sheet have been sold since the close of the fiscal year at prices in excess of their book value, and the rest will be sold from time to time through the United Electric Securities Company and other channels as heretofore.

The amount now being paid in dividends (exclusive of those received on the stocks of the underlying companies) and interest on your Company's holdings of stocks and bonds shown in the balance sheet exceeds the amount required to pay interest on your Company's $10,000,000 outstanding debenture bonds.

After careful examination, deductions have been made from the notes and accounts receivable to cover fully all bad and doubtful items.

The item "Inventories" represents all the Company's stock of apparatus, material, machinery, fixtures, etc., in the offices and storehouses of your Company's seven districts, and includes the machinery, tools, and material in the various repair shops connected with such District Offices.

"Work In Progress" represents the actual cost to date of all labor, material, etc., on unfinished contracts now in course, which, when completed, will afford a considerable profit.

The cost of patents acquired by your Company during the eight months has been charged off as an operating expense.

CONTINGENT LIABILITIES.

Your Company makes a practice of endorsing and discounting some of the notes it takes from its customers. Such endorsed notes are not included in notes receivable in the balance sheet, where only those now held by your Company are taken into account. The outstanding notes receivable which had been endorsed and discounted on January 31st, 1893, amounted to $3,787,312.69.

C. A. Coffin, *President*.

UNDERLYING COMPANIES.

EDISON GENERAL ELECTRIC CO.

The cost of acquiring 149,699 shares of the capital stock of the Edison General Electric Company was	$14,969,900 00	
Less net amount credited to that Company, after charging it with money advanced, and with an arbitrary amount of $695,000 as a guarantee against its customers' notes and accounts transferred to the General Electric Co., and after crediting it with sundry assets taken over by this Company	6,336,691 54	
Making present cost, as shown on the Balance Sheet		$8,633,208 46
This amount represents the following:		
Manufacturing Plants, being the investment in lands, buildings, machinery and tools at Schenectady, N. Y., and Harrison, N. J.	$2,677,548 09	
Machinery and materials sold to U. S. Wire & Cable Co. but not yet paid for	282,147 76	
*Schenectady and Harrison Factory Inventories	2,576,887 14	
Cash and Notes and Accounts Receivable	409,117 86	
Total	$5,945,700 85	
Less Debt	1,551,660 71	4,394,040 14
Leaving		$4,239,168 32

represented by Patents which have cost the Edison Company about $2,000,000; and by holdings of the entire capital stocks of Edison underlying patent owning companies, under contracts with which all large Edison Licensees give to the Edison Company a percentage of their entire issue of stocks and bonds.

THOMSON-HOUSTON ELECTRIC CO.

The cost of acquiring 399,347 shares of the capital stock of the Thomson-Houston Electric Company was		$18,381,970 00	
Less net amount credited to that Company, after charging it with money advanced, and with an arbitrary amount of $1,000,000.00 as a guarantee against its customers' notes and accounts transferred to the General Electric Co., and after crediting it with sundry assets taken over by this Company		9,965,118 22	
Making present cost, as shown on the Balance Sheet			$8,416,851 78
This amount represents the following.:			
Manufacturing Plant, being the investment in lands, buildings, machinery and tools at Lynn, Mass.		$1,240,066 77	
*Lynn Factory Inventory		2,263,347 59	
Cash and Notes and Accounts Receivable		428,126 91	
Raw copper		135,525 94	
Consignments		8,396 71	
Stocks of the Brush, Excelsior, Fort Wayne and Schuyler Electric Companies, and stocks of other manufacturing and patent owning companies (par value $7,312,980) carried at	$4,013,420 11		
Stocks of the Central Thomson-Houston, Eastern Electric Construction, Northwest General Electric, Thomson-Houston Electric Light and Thomson-Houston Motor Companies (par value $1,468,350) carried at	891,750 00		
	4,905,170 11		
Liquidation value, say		2,500,000 00	
		$6,575,463 92	
Less Debt		1,547,964 21	5,027,499 71
Leaving			$3,389,352 07

represented by patents, including Brush patents on double carbon arc lamps, storage batteries and patents on current regulation, all of which have been sustained in the United States Courts, and by about 1,400 other patents owned by the Thomson-Houston Company and manufacturing companies controlled by it.

THOMSON-HOUSTON INTERNATIONAL ELECTRIC COMPANY.

The entire capital stock of the Thomson-Houston International Electric Company was acquired at a cost, as shown on the Balance Sheet, of		$1,212,000 00
This amount represents the following:		
Stocks of Other Companies	$13,139 00	
Cash and Notes and Accounts Receivable.	468,076 02	
Charges against its Branch Offices	468,944 69	
Inventory and Consignments	39,049 98	
	$989,209 69	
Less Debt	307,953 32	681,256 37
Leaving		$530,743 63

represented by the rights in foreign countries under patents of Thomson, Rice and others, including contracts for delivery of $100,000 stock of the Canadian General Electric Company and substantial interests in other manufacturing and exploiting organizations in foreign countries.

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* Included in this amount are shares of the Edison Electric Illuminating Companies of New York, Boston, Brooklyn, Philadelphia and Chicago of a par value of $2,625,800. The present market value of these stocks is in excess of $3,400,000, although taken in the balance sheet at $3,024,695. Besides these there have been acquired, in the usual course of business, shares of one hundred and thirty-seven other companies, a large part of which will probably be disposed of through the ordinary channels.

* Raw materials, materials in process of manufacture with labor thereon added, and finished apparatus in stock, ascertained by actual inventories figured on liquidating values, *i. e.*, raw material at *present* cost prices, apparatus finished and in process of manufacture at cost of labor and material, and obsolete apparatus at "scrap" value.

BALANCE SHEET, GENERAL ELECTRIC CO.

CONDENSED BALANCE SHEET—JANUARY 31st, 1893.

ASSETS.			
Investment Accounts:			
STOCKS OF UNDERLYING COMPANIES:			
Thomson Houston Electric Co...	$8,416,851.78		
Edison General Electric Co......	8,633,208.46		
Thomson-Houston International Electric Co..........	1,212.000.00	$18,262,060.24	
REAL ESTATE:			
Edison Building, N. Y. City......	410,804.62		
Less Mortgage thereon.........	200.000.00		
	210,804.62		
Other Real Estate..............	87,922.12	298,726.74	
STOCK OF UNITED ELEC. SECUR. CO.:			
Preferred (Par, $454,800.).........	408,870.00		
Common (Par, 825,500)..... ..	825,500.00	1,234,370.00	
STOCKS OF MANUF. AND OTHER COS.:			
Can. Gen. El. Co. (par, $1,000,000.)	1,000,000.00		
Excelsior El. Co. (par, 6,000.)	1,300.00		
Ft. Wayne El. Co. (par, 704,700.)	352,350.00		
N'west Gen. El. Co. (par, 155,000.)	155,000.00		
Miscel. Companies (par, 481,083.)	71,566.00	1,580,216.00	$21,375,372.98
Other Assets:-			
STOCKS AND BONDS OF LOCAL CO'S.:			
Stocks (par, $11,362,011.65)........	$5,772,622.80		
Bonds (par, 4 858,380.00)........	3.400,629.07	$9,173,251.87	
CASH..............................	3,871,033.58		
NOTES RECEIVABLE...........	5,151,950.64		
ACCOUNTS RECEIVABLE.	7.078,879.15	16,101,863.37	
INVENTORIES........................	2,307,225.13		
Less 10%..........................	230,722.51	2,076,502.62	
WORK IN PROGRESS.................		2,207,982.75	29,559,600.61
			$50,934,973.59

LIABILITIES.		
CAPITAL STOCK:		
Common...................................	$30,426,900.00	
Preferred..................................	4,236,900.00	
		$34,663,800.00
5% GOLD COUPON DEBENTURE BONDS,		10,000,000.00
Other Liabilities:		
ACCRUED INTEREST ON DEBENTURE BONDS.	$83,333.32	
DIVIDENDS DECLARED BUT UNPAID.......	608,538.00	
NOTES AND ACCOUNTS PAYABLE.................. .	4.554,347.68	
		5,246,219.00
SURPLUS JANUARY 31st, 1893........................		1,024,954.59
		$50,934,973.59

STATEMENT OF PROFIT AND LOSS—JANUARY 31st, 1893.

EXPENSES.	
Interest and Discount....................	$89,513.42
Interest on Debenture Bonds	152,917.17
Dividends paid and dividends declared but not yet paid	1,971,056.50
Patents, now charged off................	118,151.42
Surplus carried forward..............................	1,024,954.59
	$3,356,593.10

EARNINGS.	
Net profits from the business of the eight months, over and above all expenses, deductions for bad debts, etc...........	$3,356,593.10
	$3,356,593.10

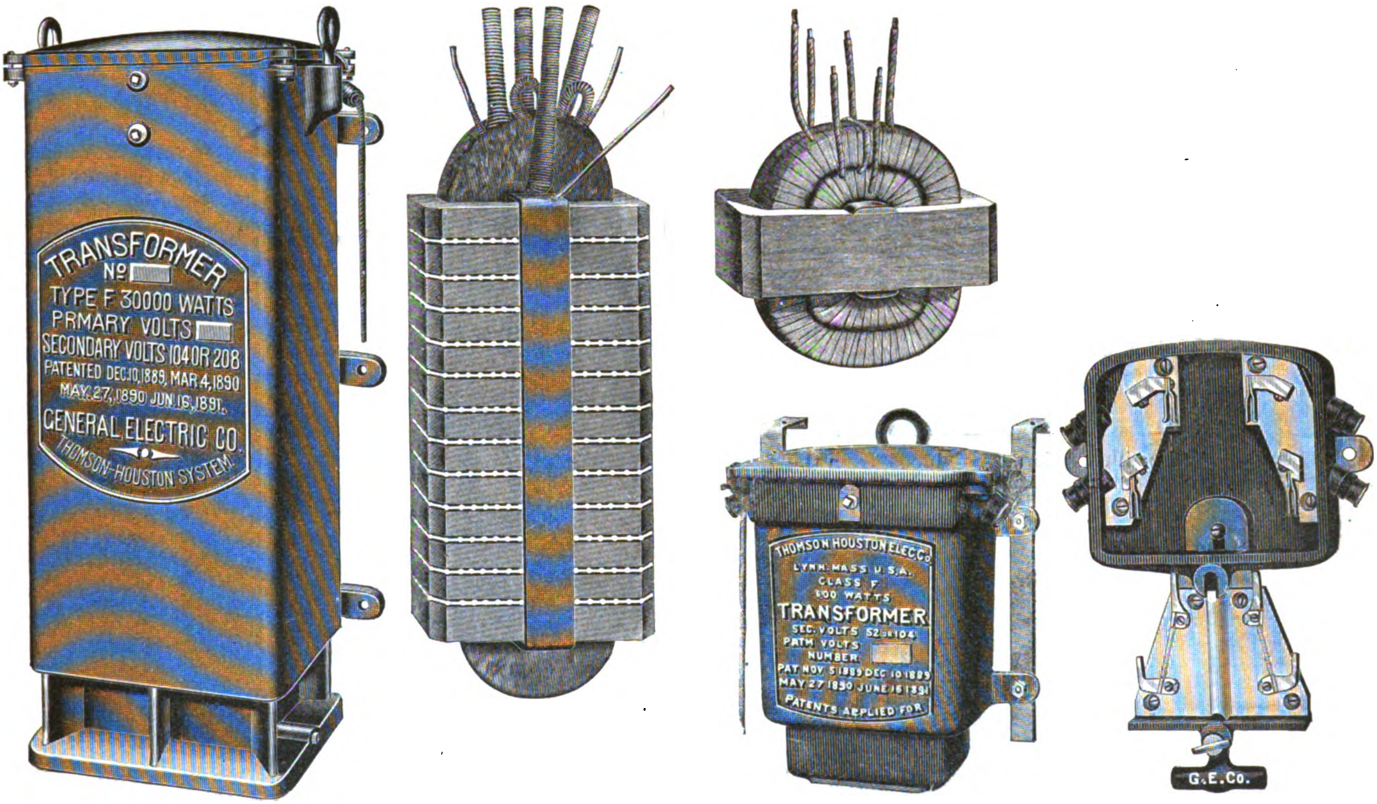
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW GENERAL ELECTRIC COMPANY TRANSFORMERS.

Almost from the time of its introduction, the alternate current transformer has been an efficient device, but it has required years of practice to make manifest its shortcomings, and numerous experiments, in order successfully to overcome them,

The essential characteristics of a good transformer are perfect safety, high efficiency, good regulation, small core loss and convenience of installation. In the "F" type of General Electric Company's transformers, perfect safety is attained by insulating by the best mechanical means; by the use of oil as an additional insulation; by the provision of a core ground wire; by the subdivision of the primary and secondary coils, and by the absence of all fuses in the transformer case. The additional insulation given to the transformer by the use of oil renders its insulation as nearly perfect as human ingenuity can devise. These oil filled transformers have been subjected to numerous stringent tests, and it has been found necessary to increase the potential to more than 11,000 volts alternating before the insulation between the coils could be broken. After allowing the apparatus in which the insulation had just been broken by this high potential to stand a short time, the test was again applied, and not until the potential had been increased to over 5,000 volts alternating did the insulation give way the second time. The value of oil, as an additional insulator may therefore be said to be conclusively proved.



General Electric Co.'s Latest Types of Large and Small Transformers.

The core ground wire serves to render the transformer still more mechanically efficient, for should lightning break through the insulation of the primary coil it is carried at once to the earth, by the core wire which should be carefully grounded. Furthermore, the primary coils are themselves sub-divided. By this means, the greatest difference in potential existing between any two parts of the primary and secondary windings is only half the primary voltage, the secondary winding being the nearer to the core.

The absence of fuses in the transformer case obviates the necessity of opening the case, and eliminates whatever danger might be caused by the molten metal of the blown fuse. The fuses, in a separate box, non-combustible and waterproof, together with the primary switch, are placed in an easily accessible position, thus allowing of the relegation of the transformer to one free from disturbance. The fuses are covered with rubber tube, and it has been shown by actual test that where a certain potential will form and hold an arc in the open air across a space of seven inches, the use of tubing hinders the formation of an arc under the same potential, even across the small space of 1¾ inches. On systems using potentials of over the regular 1,040 volts, two single pole boxes are employed.

The high efficiency obtained in this transformer has been shown by exhaustive tests as well as an excellent average at all loads, increasing with the size of the transformer, is shown in the following table.

Watt capacity.		¼ Load.	½ Load.	¾ Load.	Full Load.	Drop of potential in volts.
600	52 volt sec.	84.1	90.95	93.	93.8	1.09
1,000		88.2	93.	94.	94.7	1.21
1,500		90.	94.	94.95	95.23	.95
2,500		90.25	94.82	95.45	95.74	1.43
3,500		93.0	95.7	95.8	96.	1.50
4,500		93.9	96.3	96.85	96.96	1.50
7,500		92.2	95.8	96.4	96.85	1.60
15,000	104 volt sec.	91.5	95.3	96.3	96.5	3.0
30,000		93.3	95.9	96.8	97.2	3.0

Practical uniformity of potential on the secondary winding throughout the range from full load to light load, is the test of regulation of a transformer, for the difference of only a few volts on the secondary winding from the normal, means either unsatisfactory light, or a shortening of the life of the lamp. It is to this point that the General Electric Company has given much attention with the result that their transformer gives no greater drop in potential than that shown in the last column of the table.

Core loss is an element more or less present in transformers of what make soever, due to hysteresis, or molecular friction due to rapid reversals of polarity, and Foucault or "eddy" currents. Its elimination is a problem which presents considerable difficulties, and although it is almost impossible to prevent the loss entirely, yet the high efficiency of the apparatus under consideration shows that that loss is extremely small.

The tendency of present practice is the substitution of a few large units for a large number of small ones, at points having a sufficient number of lights to warrant this step. The larger transformers constructed by the General Electric Company are designed for a capacity of 15,000 and 30,000 watts. Their size necessitates a sub-division of winding. In the 15,000 watt transformer both the secondary and the primary coils are each sub-divided into two parts; in the 30,000 watt transformer the primary winding consists of three and the secondary of two separate coils. By this means satisfactory regulation is obtained. In these, as in smaller sizes of transformers, provision has been made for a perfectly free circulation of the insulating oil about the different coils. The larger sizes have no connection boards, the terminal wires being brought out at the top of the case for connection through suitable switches and fuse boxes to the primary and secondary wires.

The accompanying illustrations show the method of construction of the transformers. The laminated core is securely fastened into the iron case by means of wooden wedges; which serve as insulation between the coils and the case. The cover to the case is slightly arched and flanged in order the better to protect the interior from mechanical injury. Each transformer is subjected to an insulation test of 5,000 volts before it is allowed to leave the factory.

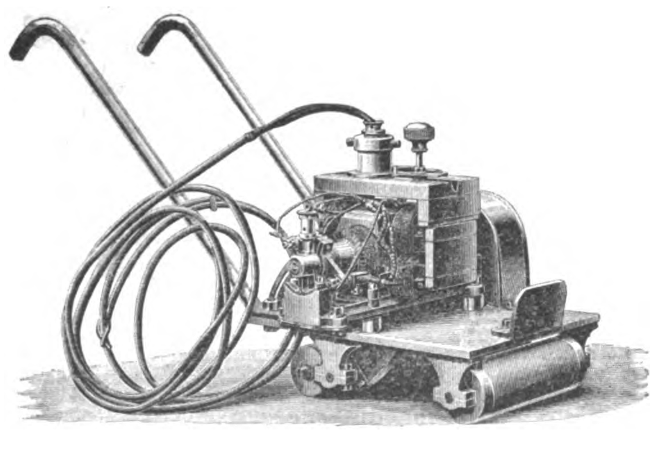
The operation of electric lights or motors at a considerable distance from the source of power has rendered necessary an even higher development of the transformer in order that transmission of the power by electricity may be economically accomplished. The system of long-distance transmission, as employed by the General Electric Company, is that of using generators, which give a potential of about 1,000 volts, and large transformers adapted to raise the potential to 5,000 volts or higher. The current thus transformed is transmitted over wires, supported upon oil insulators, to the distant receiving point, and is there re-transformed to an easily operable potential.

The line insulator employed consists of a wide glass cup with an inner flange which dips into a ring shaped, glass oil cup threaded onto the insulator pin. This construction effectually prevents any leakage of current from the wire to the supports, even in wet weather. The transformers are the same as the standard type "F" transformer except in the method of winding and insulating the coils.

Both the primary and secondary coils of the long-distance transformers are so wound as to secure the greatest possible inductive effect without any sacrifice of insulation. Mica is freely used, and the greatest care is taken both in winding and assembling to make the insulation as perfect as possible. This insulation is in all cases tested to withstand an alternating potential difference of at least 10,000 volts. The transformers are a ike with the exception of a modification in the winding, whether intended for "step-up" or "step-down" work, the primary of the "step-up" corresponding to the secondary of the "step-down." The standard size is 25,000 watt capacity, and larger sizes will be built if required. It is not considered advisable, however, to build smaller sizes than this.

AN ELECTRIC DECK PLANER.

The accompanying illustration, reproduced from the London *Electrical Review*, shows an electrical deck planer made by Messrs. W. Denny & Brothers, of Dumbarton, Scotland, and used by them to save labor in smoothing the decks of the ships built in their extensive yards. The cutter, fixed on the under side of a steel base plate, revolves at a speed of 3,000 revolutions per minute, being geared up from a motor resting on the plate and running at 2,000 revolutions. The depth of the cut is adjusted by means of eccentric journals on the rear rollers, and current is, of course, supplied through a flexible cord.



An Electric Deck Planer.

The device is said to work smoothly and quickly, and to be much in favor with the men.

FROM VOLT TO VAULT.

An employee of the Municipal Electric Light Company, who met death quickly yesterday at Fourteenth and Mallinekrodt streets, by an electric volt, was buried this afternoon from the home of his parents.—*St. Louis Star Sayings.*

MESTON $\frac{1}{8}$-H. P. SINGLE-REDUCTION MOTORS.

The Emerson Electric Manufacturing Company, of St. Louis, have recently introduced two new forms of Meston alternating current motors, shown in the accompanying illustrations. Here Fig. 1 shows a single $\frac{1}{8}$-h. p. motor geared to a countershaft by means of a rawhide pinion which, in this case, reduces the speed from 2,500 to 280 revolutions per minute and is found preferable in many cases to using a belt. It is provided with a hand or foot regulator, as circumstances require, for varying the speed or reversing the direction of motion, and the parts are designed to operate with but little friction.

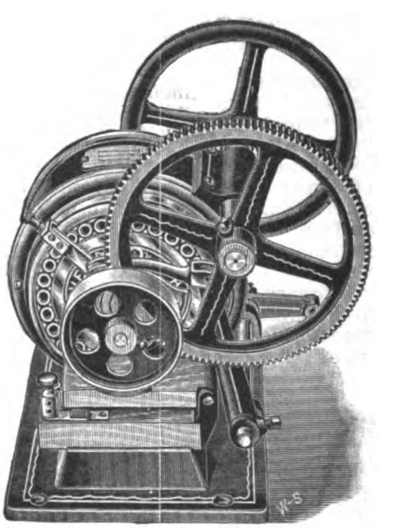


Fig. 1.—Meston $\frac{1}{8}$ H. P. Single-Reduction Motors.

Fig. 2 shows two $\frac{1}{8}$-h. p. motors geared to a countershaft, each motor being provided with an independent regulating device, while a separate hand regulator and brake varies the speed or changes the direction of both simultaneously. The motors themselves are of the well-known Meston type and require no description.

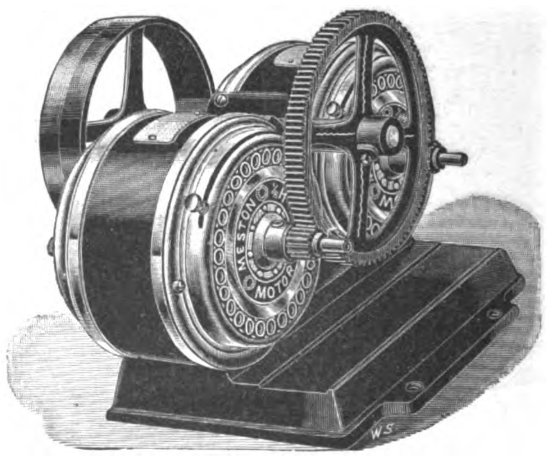


Fig. 2.—Double Arrangement of Meston $\frac{1}{8}$-H. P. Single-Reduction Motors.

The combinations are handled in the West by the Electric Appliance Company, of Chicago.

CURTIS RAILWAY MOTORS IN SUCCESSFUL COMPETITION.

The following is an interesting and significant letter just received by the Curtis Electric Manufacturing Company relative to their railway motor:—

Carbondale Traction Company,
Office of President,
Carbondale, Pa.

Curtis Electric Manufacturing Company.

Dear Sirs:—I take pleasure in stating that your motors are giving us fine service here. We have put them to some severe tests and they came through *Victors.* I think they are the best motors I ever saw and will be glad when we get the other equipments. I was very agreeably surprised to note there was a motor that could be depended on.

Yours truly,
(Signed)
H. M. Kalbach,
Superintendent.

MR. C. McL. PAINE.

We take the following from the April *Architects' Electrical Bulletin* :—

> It affords us much pleasure to announce that Mr. C. McL. Paine assumes the business management of the *Architects' Electrical Bulletin* with the beginning of this month. The growth of the journal and the warm interest manifested in it have encouraged us to secure the services of this gentleman, who is well known in the electrical field from his successful connection with the *Western Electrician*, and, lately with *Electricity*. His long journalistic experience and his popularity are elements that the *Bulletin* is glad to enlist, believing they will greatly help in the work of making the use of electricity at once safe and universal.

The *Bulletin*, which is issued monthly by the Interior Conduit & Insulation Co., under the editorship of Mr. E. W. Little, is doing really admirable work in the way of advocating better methods of wiring; and as it reaches all the architects every issue, Mr. Paine will have a splendid plea to use in pushing for business. The *Bulletin* has made a good choice of manager, and both may be wished abundant prosperity.

"BUYERS' REFERENCE."

Under the above title a series of three very handsome guides has been issued by the Buyers' Reference Company, of 114 Nassau street, New York. The editions are the "Street Railway," the "Electric Light and Power," and the "Electrical Supply and Construction." The special and peculiar excellence of these guides is that they are not mere lists of names but that in each case a description is given in clear, terse phraseology of the goods. Moreover a large amount of valuable information is interspersed so that the issues will all be worth filing. The text has been carefully edited and revised by Mr. W. J. Hammer, whose deserved reputation as an electrical engineer will in no wise suffer from this example of his work. The venture is a somewhat novel one, and certainly goes miles ahead of the ordinary buyers' guides and directories.

"NOTHING LIKE LAVA."

The D. M. Steward Mfg. Co., of Chattanooga, Tenn., report that they have a large increase in the number of customers, all of whom swear that there is "nothing like lava." Their lava electric insulators are more popular than ever. The Company did a good business last year. Their sales for 1892 were many thousand dollars in advance of those of 1891, and this year is already breaking the record. Not only is this development true of the insulator department, but all the others are keeping pace with it. The Company actually sold last year more than 5,000,000 slate pencils, 15,000 gross of their "Dustless" crayons, and 30 car loads of talc powder. Mighty is "lava"!

THE CURTIS "BOX" RAILWAY MOTOR.

The Curtis "box" motor has been making a remarkable record on one of the Pennsylvania roads, in the competition which the Curtis Electric Manufacturing Company requested the officials to make. It would appear that this company's armatures are "salamanders," as the record shows it is almost, if not quite, impossible for them to burn out under the severest conditions imposed. We understand that the company is very willing to put its "box" motor on any important road where the manager will guarantee to test it rigidly alongside of the motors of other companies. The advent of the "box" machine should be gratifying to buyers who are glad to see open competition and as many "free lances" as possible in the railway field.

FANS.

The Crocker-Wheeler Electric Company have issued a very attractive catalogue calling attention to their special ventilating and cooling devices. In its pages are illustrated and described the various types of fan motors already so well known to users of electrical apparatus, and also such improvements and additions as long experience has suggested. The company have recently moved into their new factory at Ampere, N. J., on the Montclair branch of the D., L. & W. Railroad, where, with the advantages of increased capacity and new machinery, they will do a larger business than ever.

An excellent bird's eye view of the new works is given in the catalogue.

SPUNK!

A year ago Marseilles made a contract with a local electric light company for the lighting of the streets of that village with 25 arc lights for $1,000 a year. The lights were kept up all night for four months and the village paid the company $400. For eight months since nary a light has the village seen, yet the company wants pay all the same. But there is nothing like spunk! The council got together the other evening and solemnly directed the clerk to notify the company that "a strict compliance with their contract is expected!"—Streator, Ill., *Free Press.*

BALL ENGINES FOR LIGHTING AND RAILWAYS.

The Blakely and Dickson Traction Street Railway Company, Scranton, Pa., is to be supplied with power by three 300 h. p. Ball engines, built by the Ball Engine Company, Erie, Pa.

The Nantasket Steam Boat Company, Boston, Mass., have purchased for their steamers, four "Ball" engines, built by the Ball Engine Company, Erie, Pa., to be used as power for electric lighting. J. H. Houghton, Boston, agent of the Ball Engine Company, made the sale.

THE MACKAYE SPECTATORIUM.

The Ball Engine Company, Erie, Pa., are to furnish four 150 h. p. engines for the electric plant of "The Mackaye Spectatorium" of the Columbian Celebration Company, which is to be one of the most unique and interesting features of the Columbian Exposition, and which will be to the Columbian Exposition what the Eiffel Tower was to the Paris Exposition in 1889.

LIGHTING LAKE STEAMERS.

Four "Ball" engines, built by the Ball Engine Co., Erie, Pa., are to furnish power for electric lighting on four great lake steamers, built by F. W. Wheeler Co., Bay City, Mich. These boats will be the largest on the lakes.

CONSOLIDATED CAR-HEATING COMPANY.

270 Consolidated Car-Heating Company electric heaters have been in use on the Union Railway in New York City and 96 of the same heaters have been in use by the Albany Railway. This represents the complete equipment of 61 cars, all of which have the regulating heater switch of the Consolidated Car-Heating Company. The Consolidated Car-Heating Company electric heaters are also in use to a considerable extent on several other important electric roads.

CANADIAN NOTES.

La Cie. Electrique St. Jean-Baptiste of Montreal, which now has 2,500 incandescent 16 c. p. lamps will make extensive improvements this spring, spending $50,000 in so doing. This was decided on recently at a meeting of the new officers of the company who have applied to the provincial legislature for permission to increase their capital stock to $100,000.

The $50,000 will be expended in enlarging the building and in placing an entirely new set of machinery.

The building is to be enlarged so as to cover the entire lot 92 x 142 feet and two 500 h. p. compound condensing engines will be purchased to replace the engines now in use. The lighting plant will consist of ten 1,000-light Thomson-Houston alternating dynamos and about sixty miles of No. 2 wire will be used for the lines.

The plant was erected under the supervision of a French electrician, Mr. Louis Goullioud, who is also the superintendent.

The Canadian General Electric Co. has, it is rumored, secured control of the Ball Electric Co. of Toronto. It is also said that the same company is buying control of the Royal Electric Co., so that it will have an almost complete monopoly of the manufacture of electric light and power apparatus in the Dominion. It is believed the scheme will be put through.

The Montreal Electric Co. A new concern has been started in the city under the name of the Montreal Electric Co. It is composed of well known and experienced men, and has, it is understood, an abundant financial backing. Besides carrying on a general electrical business, it will make telephones, annunciators and other small apparatus.

NEW YORK NOTES.

Messrs. J. C. Mortimer & Company, 227 Electrical Exchange Building, who deal in second-hand material and all sorts of general supplies, are advertising what seems to be a new and good scheme. They will set up an arc light plant, complete in every particular, start it running and then *rent* it to interested parties in the town, instead of selling outright. This plan should cause many small communities to be hereafter electrically lighted where at present the first cost stands much in the way.

A new electric rheostat and heater company, of Newark, N. J., George Cutter, sole agent, is making a number of cooking and heating appliances, as well as car and motor rheostats and safety switches. All these are of the tube type, which is considered by the company very far superior to that in which the wire is laid in enamel on a flat surface.

WESTERN NOTES.

CANTON, O. The handsome residence of J. C. Skelton on North Cleveland avenue is to have electric lights. The Canton-Massillon Electric Railway Company have been granted franchises for an extension of their line from Massillon to Navarre, O.; also for the streets of Navarre. The Canton-Massillon Electric Railway Company are building two new coaches which will be placed on their line between Canton and Massillon. This will enable them to run cars half an hour apart instead of one hour as at present. The Electric Company (lately incorporated) will soon be in operation for the spring trade. Leroy S. Pfouts and E. S. Lieber are the electricians.

THE ANSONIA ELECTRIC COMPANY (formerly The Electrical Supply Company) report a very pleasing reception for their latest specialty, the Helios arc lamp, for alternating circuits. They have just closed a contract for a plant for municipal and commercial lighting, in which a single alternating dynamo is to be used. Off the one circuit will be run the Helios arc lamps for street lighting, also the incandescent lamps for interior lighting. The Stanley transformers will be used in this connection. From every one who has used the Helios lamp comes expressions of the very highest satisfaction, and admiration for the work done.

THE F. P. LITTLE ELECTRICAL CONSTRUCTION AND SUPPLY CO., of 135 Seneca street, Buffalo, N. Y., report a first-class business and a very bright outlook for the coming season. They are now beginning to develop other branches of their trade, and are putting themselves in excellent shape for the manufacture on a large scale of arc lamps and electrical appliances generally. It is understood that they have already engaged Mr. Kester, of Kester arc lamp fame, and that he will take charge of their manufacturing department as superintendent and electrician.

THE ELECTRIC INSTALLATION CO.—A new company has been organized in Chicago, with offices at 912 and 918 Monadnock Building, Chicago. This company will do all kinds of engineering and contracting work, and will be called the Electric Installation Co., with officers as follows: J. I. Case, president; C. H. Holmes, vice-president; L. E. Myers, secretary and treasurer; A. H. Shewman, general manager.

THE ANSONIA ELECTRIC COMPANY. During the January blizzards of the far north-west, Mr. Charles W. Cobb, the genial and jocund traveler from The Ansonia Electric Company "did up" the electrical people of Montana and the Pacific coast. He reports a very satisfactory trip and carried in a grip full of special orders for Shield Brand wire and Habirshaw rubber covered.

THE ELECTRIC APPLIANCE COMPANY, are preparing to make a particular spread in the weatherproof wire business, having secured the Western agency for the celebrated O. K. Weatherproof line and house wires. They have large shipments on the way from the factory and will shortly be in the best possible position to make prompt Chicago shipments of any size of this wire.

THE sales of the Washington carbon, which has come to the front in the hands of the Central Electric Company, have been enormous, and the factory has been compelled to double its capacity. This condition of the trade speaks well for the quality of the carbons furnished and also for the enterprise and push of the western agents.

THE ANSONIA ELECTRIC CO., of Chicago, will soon issue a book of tables and other valuable information for electrical workers. Some of the tables have been compiled at considerable expense, and will prove of unusual interest.

THE ELECTRIC APPLIANCE COMPANY has been busy for the past week receiving and arranging their large stock of "O. K." Weatherproof and office wires and are now prepared to ship almost any kind of an order from Chicago stock. The elegant appearance of the insulation proves a great attraction to the consumer and the Electric Appliance Company report that "O. K." sells on sight.

THE CENTRAL ELECTRIC COMPANY have sold in the last few days upwards of 1,000,000 feet of Okonite in assorted sizes. The trade in this brand of wire seems to be on the increase, but, despite the heavy demands made upon the Central, they are able to keep pace with the progress and to satisfy their customers as usual.

MR. W. B. ROBERTS, general manager of the Rockford Electric Manufacturing Co., spent a day or two in Chicago recently, and Mr. Geo. A. Mayo, electrician of the company is spending a few days in the city. They both report business with their company as most encouraging.

MR. A. D. NEWTON, treasurer and general manager of the Eddy Electric Manufacturing Co., spent a few hours with us last week.

GEORGE CUTTER has been appointed Western selling agent for the fine line of insulating tubes and railway hangers made by the Fiberite Company of Mechanicsville, N. Y.

PHILADELPHIA NOTES.

THE DELAWARE HARD FIBRE CO., of Wilmington, Del., has recently made some interesting tests in regard to the tensile and crushing strength of their hard fibre, which illustrate some of the remarkable properties of that material. A sample disc 1½ inches in diameter and 1 inch thick, cut from a sheet of fibre was found to crush under a total pressure of 40 tons, which would correspond with a pressure of about 23 tons per square inch. A sample of their round rod tested by the Edgemoor Bridge Works, broke under a tensile strain of 8,600 pounds per square inch, which closely corresponds with results obtained at the Royal Technical and Mechanical Testing Department of the German Army, Berlin. Three samples which were tested there gave results varying from 8,000 to 9,000 pounds per square inch. Such results as these can only be obtained from a fibre free from clay or other adulterations.

MESSRS. QUEEN & CO., Incorporated, Philadelphia, report a steady demand for their standard portable testing resistance sets which enjoy a national reputation and are also used in foreign countries. This applies especially to "No. T305," which is claimed to be the most efficient portable apparatus for practical work, on the market. It can be used anywhere and everywhere, and is especially valuable in locating faults, or grounds in electric light, telegraph or telephone wires. An enthusiastic purchaser writes: "It is the best portable set I have ever used or worked with and consider any electric light or railway plant incomplete without one. The galvanometer I find works well even in close proximity to the intense magnetic fields of our dynamos." The set is fully described in the company's circular No. 430.

MESSRS. J. W. PARKER & CO. have sold a 300 h. p. improved Ball special railway engine to the Camden Horse Railway Co. which will operate a Thomson-Houston railway generator and is an extension to the present plant.

MR. T. L. TOWNSEND, of the Partrick & Carter Co., has started on his annual Southern and Western trip, which will be somewhat more extensive than any heretofore made.

NEW YORK NOTES.

MR. EDWARD J. WESSELS, of the Curtis Electric Manufacturing Company, has returned after a lengthy trip West. He succeeded in closing some contracts with some of the leading roads and the "Curtis box motor" will soon be in active operation West, as it is in the East. Important additions to the machinery have been made at the works of the Curtis Electric Manufacturing Company and their Jersey City plant represents the best sort of equipment. Several new machines made especially for the Company have recently been introduced. Their shipping facilities are excellent as their tracks reach the B. & O., Central of N. J., Philadelphia & Reading, Pennsylvania, and Erie roads.

THE EDISON ELECTRIC ILLUMINATING COMPANY has issued a circular notifying users of incandescent lamps that it alone has the right to sell incandescent lamps in New York city, and that all consumers must deal with it. It consents to make a negotiation for past use of infringing lamps, which will waive the claim of individual settlement for past damages, on an agreement to use licensed Edison lamps in future.

NEW ENGLAND NOTES.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., have received the contract for a new bridge at Norwich, Conn., to span the tracks of the Norwich & Worcester Branch of the New York and New England railroad, over the Shetucket River. The bridge will consist of one span of 145 feet, with a roadway 24 feet wide in the clear, and two sidewalks each five feet wide in the clear. The roadway and sidewalks will both be covered with steel buckle plates and concrete. The same company have also received the contract for the new rolling mill building from the New Haven Rolling Mill Co., at New Haven, Conn.

SOUTHERN NOTES.

MR. A. L. JOHNSTON, C. E. E. E., who has been the chief electrical engineer of the work upon the electrical system of the New Orleans and Carrollton Railroad Company, has completed his task and returned to Richmond, Va., his home. Before he left, the company adopted a very complimentary series of resolutions, referring to his energy, ability and success.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

VOL. XV. APRIL 19, 1893. No. 259.

THE "NEW SUNBEAM" INCANDESCENT LAMP.

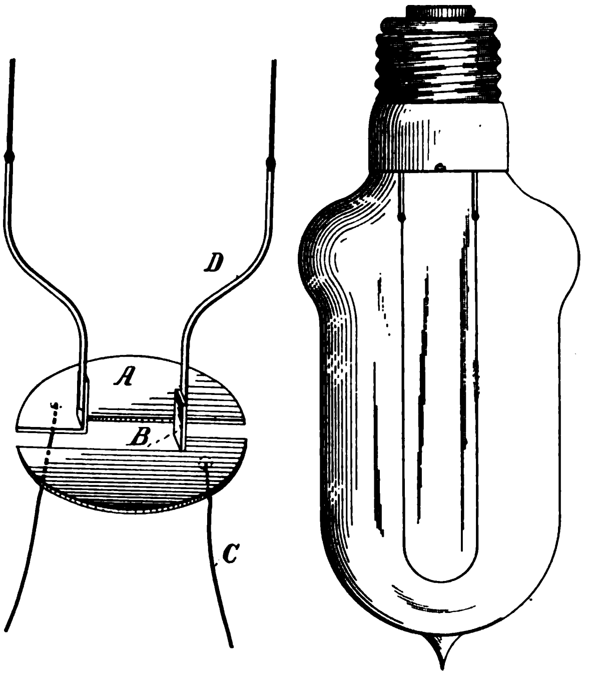
IN The Electrical Engineer of March 22 we described the new incandescent lamp patented by Mr. John von der Kammer, and as the lamp is now being manufactured by the Star Electric Lamp Company, of Chicago, under the name of "The New Sunbeam Lamp," it will no doubt be matter of interest to many to know something of the peculiar qualities of the lamp in its commercial form. The lamp complete is shown in Fig. 2, and the construction of the metallic base will be readily understood from Fig. 1. The base of the lamp as will be noted consists of two semicircular discs A, one edge of each of which B is turned up and on which the filament wire D is mounted. The copper wires C leading to the external circuit connections in the base of the lamp are soldered to the under side of the discs A. The gap between the parallel sides of the discs A is filled up with the fused glass, and the bottom of the glass globe is fused around the circumference of the discs thus enclosing them entirely in glass.

Mr. von der Kammer's method of securing the metallic plates to the glass portions of the receiver is novel and exceedingly ingenious, and at the same time is said to be thoroughly practical and quite sufficient for the purpose.

The difference in expansion between the metal base and the glass globe is of no consequence in a lamp constructed in this manner, for there is sufficient flexibility in the metal to permit it to accommodate itself to the expansion of the glass. The metal base can therefore be made of some of the baser and cheaper metals, as, for example, copper. This lamp, however, not being a vacuum lamp, the character of the gas is such that the base can be most easily made of some metal which will resist the action of such gas, as for example, platinum. The manufacturers promise soon, however, to employ in place of the platinum, some cheaper metal, preparing it in advance so as to resist the action of the gas.

The fact that the New Sunbeam has a comparatively high pressure of gas within it, renders the maintenance of a perfect gas-tight chamber of less consequence than in the vacuum lamp, and therefore, permits of the change in the construction noted. The metal seal at the base obviates the necessity of joining glass to glass in the usual manner and also the use of the internal seal piece, so that if the lamp is slightly damaged in the process of its manufacture, it may be conveniently repaired and resealed at the lower end. Moreover, this form of base and construction permits the re-using of the bulb itself, if unbroken, or, in any event, of the metal base plates.

Although the gas-filled incandescent lamp has for years been declared impracticable, Mr. von der Kammer, by the employment of various expedients, has produced a lamp which does not appear to show any of the objectionable features of gas lamps as formerly made. The new lamp, though containing a considerable quantity of gas, is said to be even cooler while burning than the ordinary vacuum lamp. There is no disintegration of the carbon and no electrical "carrying" incident to overwork, even when greatly over-run. For example, when a 100-volt lamp is run at 150 volts for a considerable time, the burner will be found to be of its normal color throughout and practically unchanged. Moreover, the character of the gas employed is such that whatever injury the burner receives or tends to receive from such over-running, is promptly and completely repaired by the gas itself, so that in most instances when the lamp has thus been over-run, it is found not only that the burner is unchanged in its form and appearance, but that its resistance is actually slightly diminished so that, for example, a 110-volt lamp burned at 100 volts for a short time, will give the full candle power at 109 volts instead of 110.



FIGS. 1 AND 2.—THE "NEW SUNBEAM" INCANDESCENT LAMP.

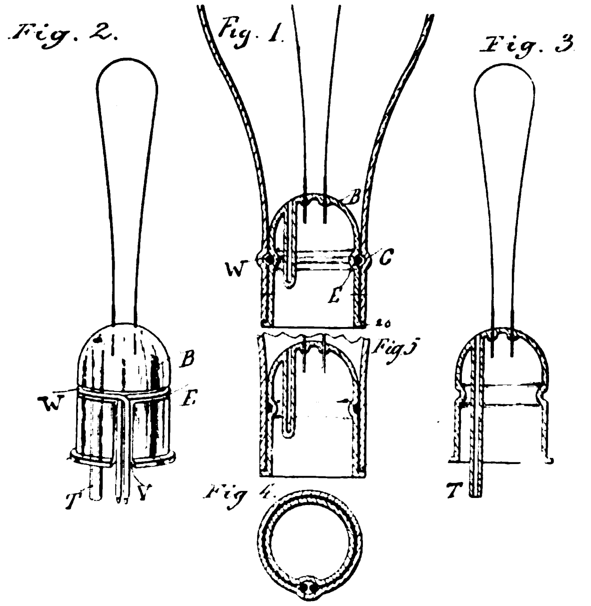
The gas which is employed is produced, we understand, from a very rare substance, and one which the inventor and the chemists of the company assert, has never before been used in connection with incandescent lamps. The manufacturers of this lamp claim for it great utility for certain uses, on account of the quality above referred to, as for example, on all such circuits as are supplied with currents of varying pressure. The fluctuation of several per cent. in the current will not vitiate the lamp or increase the resistance of its burner, at least, not until such fluctuations have extended over a long period, or in other words, the practical life of the lamp.

Besides the advantages in its service as above suggested, the manufacturers state that there is a great change in the method of manufacture. Gas being constantly present in the lamp, and the means of preserving or repairing the carbon being constantly at hand, the lamp requires no such elaborate process of manufacture as does the vacuum lamp.

RECENT IMPROVEMENTS IN STOPPER LAMPS.—THE BENJAMIN AND THE GREEN.

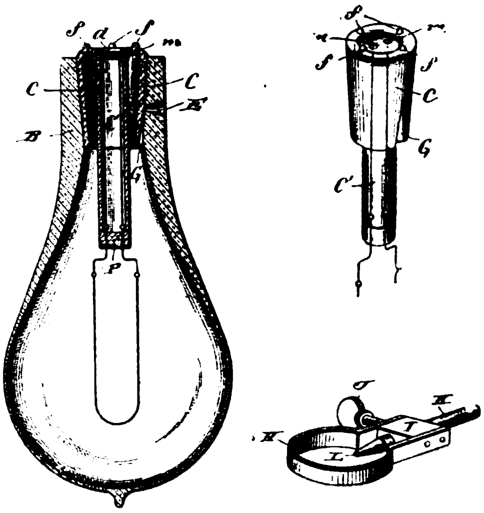
That "Necessity is the Mother of Invention," is again being exemplified in the devices which are rapidly multiplying, the object of which is to produce an incandescent lamp which shall be outside the claims of the monopolistic Edison lamp patent. We have already illustrated a number of such and are able again to present a couple which have recently issued from the Patent Office. Among these we notice one due to Mr. Geo. H. Benjamin, of this city, which is assigned to Messrs. Siemens & Halske, of Berlin, and which is illustrated in the accompanying engraving.

Mr. Benjamin's lamp is of the stopper type, the neck being provided with a groove C on its inner surface, the lower inner portion of the neck being ground to cylindrical shape. The base piece B, is hollow and rounded at the top and provided with a groove E on its external surface which corresponds to the groove C in the neck of the lamp. It is also provided with a vertical groove V and a flange, which fits over the lower edge of the neck. The air is exhausted from the globe by means of a tube T, which, after exhaustion is complete, is sealed off. Mr. Benjamin does not depend upon the ground joint for the maintenance of the vacuum in the lamp, but in order to perfect the seal he employs a fine wire W covered with an insulating material and wound in the groove C, crossed and then carried down to groove V, so that its terminals extend outside of the base piece as shown in Fig. 2. Before pressing the wires in the grooves, the wire itself is covered and the grooves filled with a paste, which, when subjected to heat and then cooled, becomes hard and non-porous. The material employed by Mr. Benjamin for this purpose is of hydro-carbon, very much of the nature of the cement used for uniting carbon filaments to the leading-in wires in incandescent lamps. An amalgam or alloy composed of lead (nine parts), antimony (two parts), bismuth (one part), can also be used. After the insertion of this material, the outer surface of the base piece B is covered with thin varnish and pushed into position in the neck of the globe so that the two slots C and E register. A current is then sent through the wire W which heats the carbonaceous material, thoroughly carbonizes and renders it hard when the process is finished. The glass of the globe and neck around the groove is compressed as shown in Fig. 5. When an amalgam is used it is only necessary to bring the material to a melting point by the action of the current and then it compresses the glass. The result of the method, according to Mr. Benjamin, is a perfectly air-tight joint.



Figs. 1, 2, 3, 4 and 5.—The Benjamin Stopper Lamp.

In another form of stopper lamp, the invention of Mr. Henry Green, of Hartford, the inventor's object is to construct a lamp in which the vacuum can be created repeatedly, the globe cleaned and the filament replaced without rendering any part of the lamp useless. By referring to the accompanying illustrations, Figs. 6, 7 and 8, it will be seen that the neck of the lamp is made thicker at the top for the purpose of allowing sufficient space for the insertion of the point L, the object of which will be explained presently. The stopper C is made of glass and ground in as a longitudinal groove G brought to a needle point at the upper end; this groove registers with the funnel-shaped aperture E for the purpose of opening and closing communication with the interior of the globe. *f, f, f, f*, are four little projections which facilitate the use of a wrench for turning the stopper in and out of registration.



Figs. 6, 7 and 8.—The Green Stopper Lamp.

The clip H which encircles the outer neck of the globe is used for the purpose of securing the point L with the base piece in the funnel-shaped aperture E while exhausting the lamp.

A disc of insulating material D is secured at the head of the opening in the stopper C where the leading-in wires pass, and is secured on the outer side to two metal plates M M in which the wires terminate. The block I forms part of the clip H through which the tube K passes and is held firmly in the aperture E by a thumb-screw.

CONVERTING INCANDESCENT LAMPS INTO GEISSLER TUBES.

Writing to the *Scientific American*, Mr. E. M. La Boiteaux describes the following simple method of converting incandescent lamps into Geissler tubes:—

Procure a burned-out lamp, if possible one in which a piece of the filament has been broken off, leaving the ends separated about an inch. Solder a piece of wire to each terminal of the lamp, and connect to the secondary terminals of an induction coil yielding about a one-eighth inch spark. Start the coil in action, and holding the globe in one hand, begin to file off the glass point where the lamp has been sealed. This operation must be performed very cautiously, using a fine file with a gentle pressure.

The filing should be continued until the discharge diffuses the bulb, and then the point is quickly sealed in the flame. It is, of course, apparent that the object in filing the point is to allow a certain amount of air to enter the globe, producing a low vacuum, through which the discharge will readily pass. Quite a number of beautiful and varied luminous effects may be obtained in this manner by using lamps of different manufacture and with very little trouble.

THE JONES ROTARY ELECTRIC DRILL.

Mention has already been made in these columns of the rotary electric drill invented by Mr. R. M. Jones, of Salt Lake City, Utah, and we are now enabled to give a detailed description of its construction and method of operation.

The drill has been designed with the view of enabling it to be handled in an easy manner, and on the other hand so that it should be capable of withstanding the very rough usage to which most mining machinery is subjected. The construction of the drill will be readily understood from an inspection of the engraving, Fig. 1, which shows it complete and of Figs. 2 and 3, which give views of the various parts, both assembled and in detail.

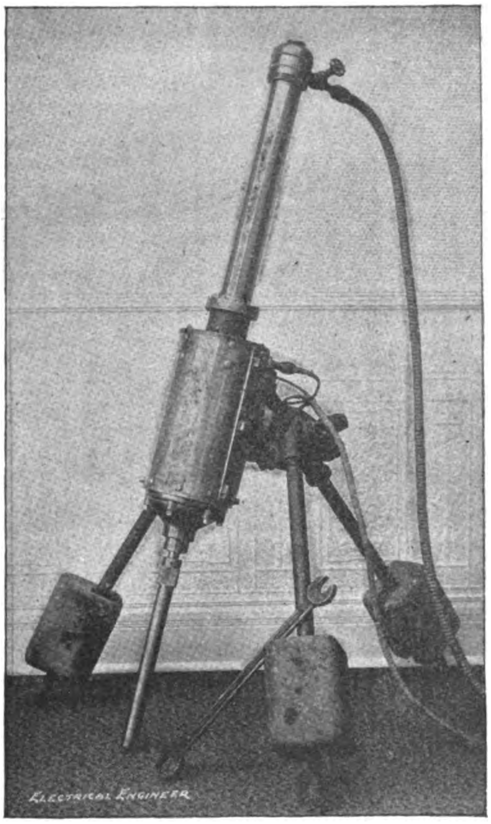


Fig. 1.—The Jones Rotary Electric Drill.

Motion is transmitted to the drill by the armature which rotates in a bi-polar field containing four magnet spools and wound alike for all types, but connected differently for the various voltages; the only change required being the substitution of a suitably wound armature, to conform to the changed voltage.

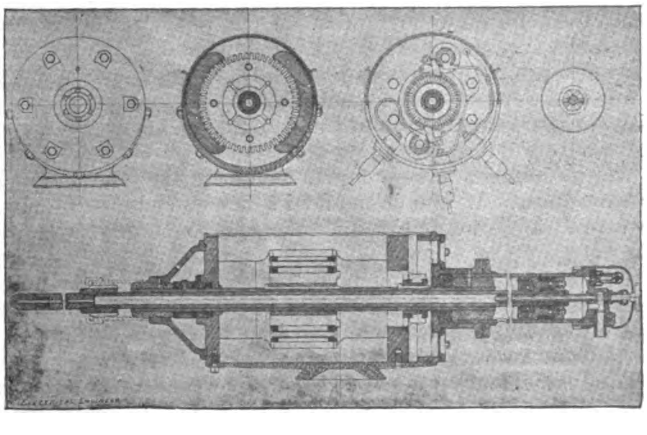


Fig. 2.—Sectional Details of The Jones Rotary Electric Drill.

Inasmuch as direct current is used in operating this machine with either 125, 250 or 500 volts for underground mining, and as it has also hydraulic pressure for giving pressure upon the bit and for washing out borings, it makes an excellent apparatus in combination with the various kinds of mining machinery which are now on the market, enabling the drill to be used with the standard direct current, applied to motors for various purposes in mines and mills.

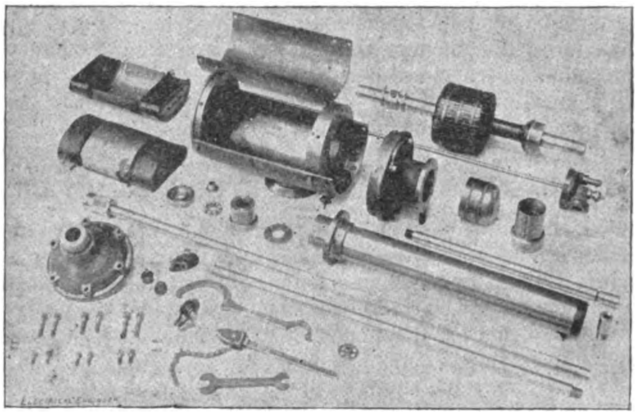


Fig. 3.—Parts of The Jones Drill Before Assembling.

During a recent exhaustive test of the Jones drill, which we illustrate in Fig. 4, the holes bored were 1⅝ inches in diameter, through a large boulder of dolomite or black limestone, which formation is considered in the west much harder than any of the grades of granite, and equally as hard as any formation which is found in the mountain region. The drill accomplished a speed averaging 3½ to 6 inches per minute; the bit entering one side of the boulder and passing entirely through it, taking out an excellent smooth core, which enables the operator to examine the quality of the formation during drilling process. This work was done with the average consumption of 10 amperes and 224 volts direct current, or practically three horse-power, and producing results superior to those obtainable by the use of compressed air drills. Next, 2½-inch holes were bored with the same machine, using the same current, and with nearly the same rapidity. This bit took out a 1-inch core, which may be readily used in core

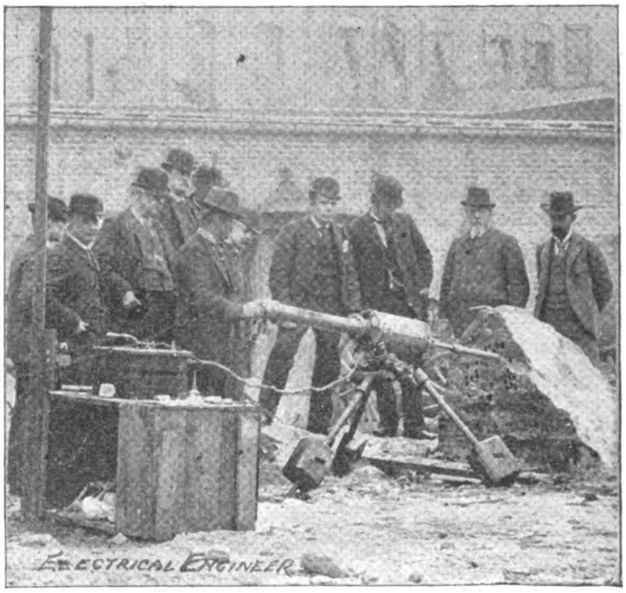


Fig. 4.—Testing The Drill on Hard Rock.

prospecting, to a depth of probably 200 feet for down or up holes, but for a shorter distance horizontally.

The machine proper weighs 275 pounds, and can be handled easily by two men, and is made to apply directly on either the Rand or Ingersoll columns or tripods. The motor is practically waterproof, being jacketed, and is thoroughly packed to prevent damage from short circuits while working in wet mines. We understand that the General Electric Company have undertaken the manufacture and exploiting of this apparatus in connection with their other mining machinery.

THE NEW STANDARD KENNELLY AMMETER.

We illustrate in the accompanying engravings a new standard ammeter, designed by Mr. A. E. Kennelly, of the Edison Laboratory and which embodies in its construction a number of novel principles. The instrument is shown in perspective in Fig. 1, and Fig. 2 gives a view of the working parts.

As will be seen, the instrument consists of a flat horseshoe magnet with its poles brought out into semi-circles facing each other and separated by about $\frac{1}{16}$ of an inch. This large surface and narrow air-gap make a magnetic circuit very nearly closed. It is well known that a solid anchor ring of steel uniformly magnetized round its circumference has no demagnetizing force, and therefore no tendency to alter its magnetization. A saw cut across such a ring introduces an air-gap, that establishes a demagnetizing M. M. F. equal to the product of the flux and the air-gap reluctance. As the air-gap broadens, and its reluctance rises, this back M. M. F. increases, making the magnetic condition of the whole circuit more and more unstable, and rendering it more difficult to find a quality of steel that will have sufficient hardness and retentiveness to withstand this demagnetizing influence, while the narrower the air-gap the more permanent and stable the magnetic condition must remain.

In the narrow space between the semi-circular pole faces, is pivoted a disc armature, as shown in Fig. 2, the plane of the disc being parallel to the polar surfaces and midway between them. Starting from the centre, the insulated wires forming the armature winding are laid radially and symmetrically over the upper surface of the disc, the accuracy of angular spacing being mechanically preserved. One-half of the disc is completely covered by the pole faces, and the other half projects beyond them. Two spiral springs bring the measured current into and from the disc, acting at the same time as a restoring couple, as in the instruments of Cauderay and Gimingham of 1886.

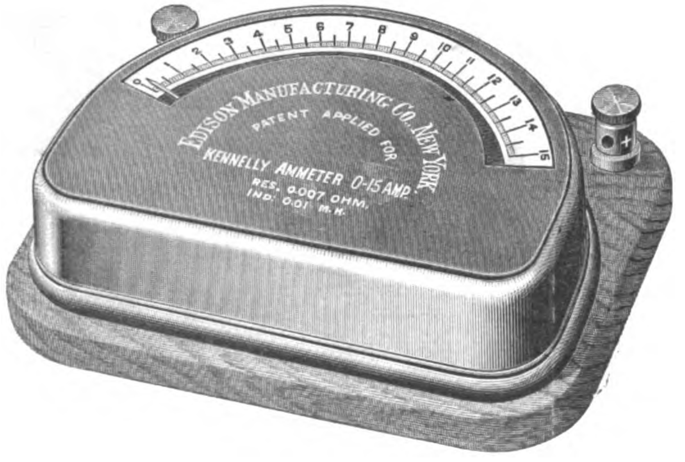


FIG. 1.—THE NEW STANDARD KENNELLY AMMETER.

When the current passes through the armature, an electromagnetic pull is set up in the plane of the disc, urging it to right-handed or left-handed rotation according to the direction of the current. As the disc moves in obedience to this force, as many radial wires enter the poles on one side, as leave them on the other, so that the electromagnetic force corresponding to the current strength remains uniform while the retractive force from the spiral springs increases directly with the angle of displacement. In this way, the angle through which the disc and its attached pointer move, is proportional to the current strength, and the graduations of the scale are nearly uniform. The scale itself is wide, and covers an arc of about 125 degrees.

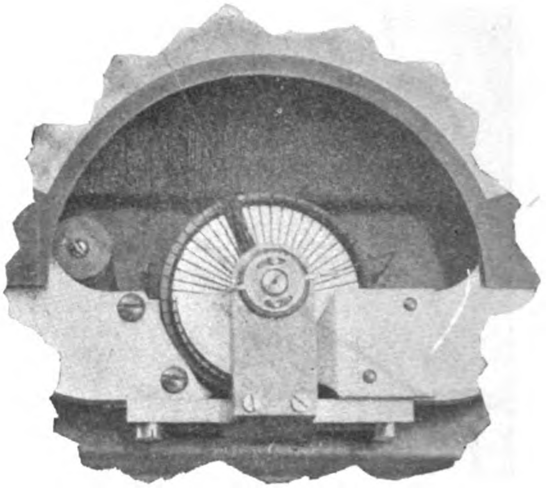


FIG. 2.—INTERIOR OF THE NEW STANDARD KENNELLY AMMETER.

The shaft bearing the disc is pivoted on agates to reduce friction, and the whole armature complete only weighs a few grammes, so that it is not liable to be damaged in transport. The instrument will register in any position, but is most sensitive when resting horizontally. The total absence of iron from the armature insures freedom from hysteresis or magnetic lag.

A considerable advantage possessed by this form of ammeter is its independence of the distribution in magnetic flux through the armature. If this consisted of a spool or compact coil moving from one part of the field to another, under the influence of the current, the electromagnetic force and consequently the deviation of the pointer would depend upon the local intensity of field at the point then occupied by the coil, so that accidental variations in the distribution of flux between the poles of different instruments would essentially produce corresponding variations in their scales. In this instrument, however, the winding is spread uniformly over the surface of the disc armature, which is only partly covered by the field, and consequently no movement of the armature within the range of indication can alter the relation between winding and magnetic field however irregular the latter may be, for as many wires enter the field as leave it, and if any part of the winding is exposed to an unduly great or unduly feeble flux density at the outset, the same number of wires will always remain under that influence, throughout the motion.

The instrument is very light, weighing six pounds in its wooden case. It can be made in any capacity up to 100 amperes. It is not affected by the earth's magnetic force, nor even by the stray field from dynamos beyond a few feet radius. Its resistance and inductance are very low. Its frame is very strong and compact, being supported entirely on the magnet, which is again secured to the base with the intervention of soft-rubber washers.

The instruments are all adjusted and standardized at the Edison Laboratory, by comparison with the standards there maintained. The scales are read off over mirrors to avoid parallax, and the movements of the needle are practically deadbeat. It it believed that no instrument of its type has yet made its appearance in which the magnetic circuit is so nearly closed, and this is the special advantage of the disc armature form.

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T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
Western Editor and Manager, L. W. COLLINS, 575 The Rookery, Chicago, Ill.
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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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THE GENERAL ELECTRIC COMPANY'S REPORT.

IN its issue of last week THE ELECTRICAL ENGINEER printed the Annual Report of the General Electric Company in full, putting it into its readers' hands on April 12, the day after the Stockholders' meeting at Schenectady, and a week in advance of all its electrical contemporaries.

The most conspicuous feature of the report is its bold showing—in the schedule called "Underlying Companies"—that $8,159,264.02 of the company's assets is represented by patents, license contracts and other intangible interests that may be called "good-will" of the Edison and Thomson-Houston Companies, together with the sum ($1,695,000.00) charged those companies "as a guarantee against their customers' notes and accounts transferred to the General Electric Company." The real value of the "notes and accounts—guaranteed at $1,695,000.00"—no one outside of the company's confidence can estimate; but we are aware of no reason to suppose them to have been over-valued. It will be noted that the amount standing for patents, license contracts, etc. (good-will), is nearly commensurate with the difference between the sum of the surplus of the Edison General Company and that of the Thomson-Houston Company, as stated in their last reports previous to the consolidation, and the surplus now reported by the General Electric Company.

In the annual reports the amounts were stated as follows :—

Edison General Electric Company, October 31, 1891, Surplus	$1,260,067.11
Thomson-Houston Electric Company, January 30, 1892, Surplus	7,546,947.96
	$8,807,015.07
General Electric Company surplus, January 31, 1893	1,024,954.59
Difference	$7,782,060.48

The difference in united surplus has, of course, gone into the increase of capital stock. The capital liabilities of the General Electric Company, January 31, 1893, are given as :

Common stock	$30,426,900	
Preferred "	4,236,900	
		$34,663,800
Bonds, 5 per cent. Debentures, Gold		10,000,000
Total		$44,663,800

The capital liabilities of the two component companies were:

Edison General, October 31, 1891.			
Capital stock,	$11,849,400		
Notes payable in Stock at par,	2,000,000		
		$13,849,400	
Thomson-Houston, January 30, 1892.			
Capital Stock, Common,	$6,000,000		
" " Preferred,	4,000,000		
		$10,000,000	$23,849,400
Increase in capitalization,			20,814,400

As it appears above, about $8,000,000 of the increase extinguishes an equivalent amount of surplus, and about the same amount is now represented by patents, license contracts, etc. The authors of the report may be commended for frankness in the latter regard, while at the same time one may take leave to doubt whether the patents and contracts owned by the General company are worth any such sum as seven or eight millions of dollars. It is interesting to note that in the last previous reports the valuations put upon patents, as assets, were :—Edison Co., $322,848; Thomson-Houston Co, $338,354; together, $661,202. In the text of the report it is stated that the royalties from about thirteen hundred local companies aggregate from $1,500,000 to $2,000,000 per year, and that it is believed that the royalties will be greatly increased in the future. The royalties, it is to be presumed, come in the way of stocks and securities of local companies and dividends upon them. Many of the local companies are, no doubt, steadily improving their condition and augmenting their earnings; but, in view of the short period of life remaining to the fundamental Edison lamp patent, and of the activity of inventors in devising new lamps, it seems unlikely that royalties, in any form, can be exacted from lighting companies after a year or two. If the General company could realize nearly $2,000,000 per year from royalties for five or six years it might present a balance sheet in which neither patents nor good-will should appear among its assets. We make bold to doubt its ability to do so. The report gives no statement of total business or of gross earnings and no details of revenue, but states net profits only. The net earnings are given as $3,356,593.10 for eight months from June 1, 1892, to January 31, 1893. The profits of the Edison and Thomson-Houston Companies, as given in last previous reports were:

Edison Company, year ending Oct. 31, 1891,	$2,272,696.00
Thomson-Houston Company, year ending July 30, 1892	2,760,780.25
	$5,033,476.25

Computing the net earnings of the General company for a year on the basis of the result for eight months, as stated in the report, they would amount to $5,034,889.65—or almost exactly the same as the combined earnings of the two component companies according to their last yearly statements. This does not seem to afford an encouraging outlook for the largely increased capitalization.

ARE THEY RAILWAYS OR TRAMWAYS?

A DECISION of much importance to electric railway companies in Canada, has just been rendered by the Exchequer Court at Ottawa, which apparently allows them the same privilege of importing rails free of duty as is enjoyed by steam railway companies.

The case in question was that of the Niagara Falls Park & River (electric) Railway Co. vs. the Queen, in which the suppliants complained that they were improperly compelled to pay duties to the extent of $4,320 on steel rails imported from England. These, they claimed, should have been free of duty by reason of the provision of the Customs Tariff that "steel rails, weighing not less than 25 pounds per lineal yard, for use in railway tracks, are free."

The Crown, in opposition, contended that electric railways were not "railways" but were "tramways," and as such, the rails, though weighing over 25 pounds per lineal yard, were not exempted by the above mentioned clause from the duty of $6 per ton. However, before trial, the Crown counsel abandoned the case and consented to the suppliants recovering the amount of the duties. Judgment was entered accordingly.

It will be noted that the new legislation in Connecticut insists that electric roads are railways and not tramways.

STATE REGULATION OF ELECTRIC RAILROADS.

THE question of the State regulation of electric railways is being actively discussed in Massachusetts. In their annual report to the legislature, of which some notice is given elsewhere, the Railroad Commissioners have called attention to the fact that electric lines are rapidly multiplying in every direction, and that while assuming many of the functions and privileges of steam-railways, they were nevertheless amenable only to the general statute enacted many years ago for the government of street-railways, which changed circumstances had rendered wholly inapplicable and insufficient. It appears, for example, that the limit of actual capital required to be paid in is only $10,000 per mile in cities, and $2,500 elsewhere, while there is no limitation whatever upon the amount of bonds which may be issued. Under the present law, moreover, a majority of the board of selectmen of any town may grant a location to an electric railroad in any street or public highway, and may authorize it to cross any existing steam-railroad at grade.

The existing condition of affairs, which is due to the sudden and radical change which the introduction of electric power has wrought in the character and purposes of the street-railway, obviously opens the way to abuses and dangers of the gravest character. A bill was accordingly introduced in the legislature last month, at the instance of the steam-railroad companies, requiring the consent of the Railroad Commissioners for a street-railway using electric power to cross the tracks of a steam-railroad at grade. Other bills, amending the existing law in respect to the requirement of capital to be paid in, and limiting the amount of bonds which may be issued per mile of road, have also been introduced, and will probably be passed. There can be no question that these reforms are imperatively demanded, not only in the best interests of the railroad companies themselves, both steam and electric, but especially in the interest of the traveling public. The present situation, not only in Massachusetts, but even to a greater degree in some other States, is fraught with possibilities of the greatest dangers, both physical and financial, and is one which calls loudly for immediate and thorough reform. The Massachusetts Commission, composed as it always has been, of men selected for their fitness, rather than from political considerations, may be trusted to deal with the administrative questions involved, in a conservative, and at the same time an enlightened spirit, and it is to be hoped that the matter may be placed in their hands as speedily as possible.

DIAGONAL RUNNING OF TELEPHONE LINES.

THE Technical Bureau of the Pressburg Telephone Service has recently introduced what is claimed to be a new method of running telephone wires. Instead of carrying the principal lines along the front or on the roof of the houses, the wires are run zig-zag fashion, that is to say, first on the right and then on the left-hand side of the street, no matter what may be the length of the span. For instance, the first may be 60 metres, the second 150 metres, and the third 80 metres. By this means it is said that fewer supports and insulators are required. This is shown by the statement that when formerly the bureau used from 30 to 40 supports, it now only employs from eight to ten. It is admitted that more wire is required by the adoption of this system, but it is contended that this is very insignificant when the great saving in supports and insulators is taken into consideration. Other advantages are also claimed for this system of running telephone wires.

THE "HUNTING" OF PARALLEL ALTERNATORS.

AT a recent meeting of the London Institution of Electrical Engineers, Mr. H. E. Harrison described briefly some experiments he had made on the above subject. Mr. Harrison, it appears, was experimenting on an alternator of the old Siemens type which was running as a motor off the London Electric Supply Company's main. He found that the machine did not run uniformly, but that it "hunted;" that is to say, it ran slowly a little, then it took considerable power and quickened up till it was above speed, and then ran as a generator for a few moments, and again slowed down, and so on. He also observed that the exciting current also varied, behaving like a direct-current with an alternating-current of long period superadded. Commenting on the results in *Industries*, Mr. Jas. Swinburne considers Mr. Harrison's discovery to be one of the most important in alternating-current work made during the last few years.

EARTH CURRENTS.

IN the discussion which took place on the paper read by Mr. S. F. Walker, before the London Institution of Electrical Engineers, Mr. W. H. Preece, F. R. S., pointed out that what electricians should measure is the electromotive force between two points, and not the current that happens to be in a particular wire connecting them. If the open circuit electromotive force is taken, we have some definite information. It is important that the electromotive force of polarization of the earth plates should be eliminated, and for this two or three readings would be advisable—one on open circuit after a long rest, one after the earth current has been on some time, and one with a reversed current due to a known electromotive force in the opposite direction.

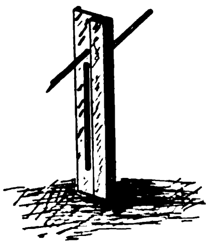
ELECTRIC RAILWAY DEPARTMENT.

THE FIRST ELECTRIC RAILWAY IN NEW ORLEANS.—I.

BY

G. Langstaff. Johnston

I.—INTRODUCTORY.



THE introduction of electric traction in New Orleans makes a very interesting story. It has not been the want of enterprise or of knowledge that the trolley system is the most economical and practical mode of electrical propulsion, that has prevented the directory of the New Orleans and Carrollton Railway Co., one of the principal street railways in the Crescent City, from adopting it years ago, instead of at this late day.

Organized in 1833 and built in 1835 as a steam road, runningfrom near Canal street which was then in the suburbs of the city, to Lake Pontchartrain, where it connected with a line of boats on the lake, and to Mobile, it did a very large business, not only in through travel, but in the freighting of cotton and sugar from the plantations contiguous to the lake, and through which it passed. From the date of its organization it boasts of being one of the pioneers in this section, with steam, as it does now of electricity.

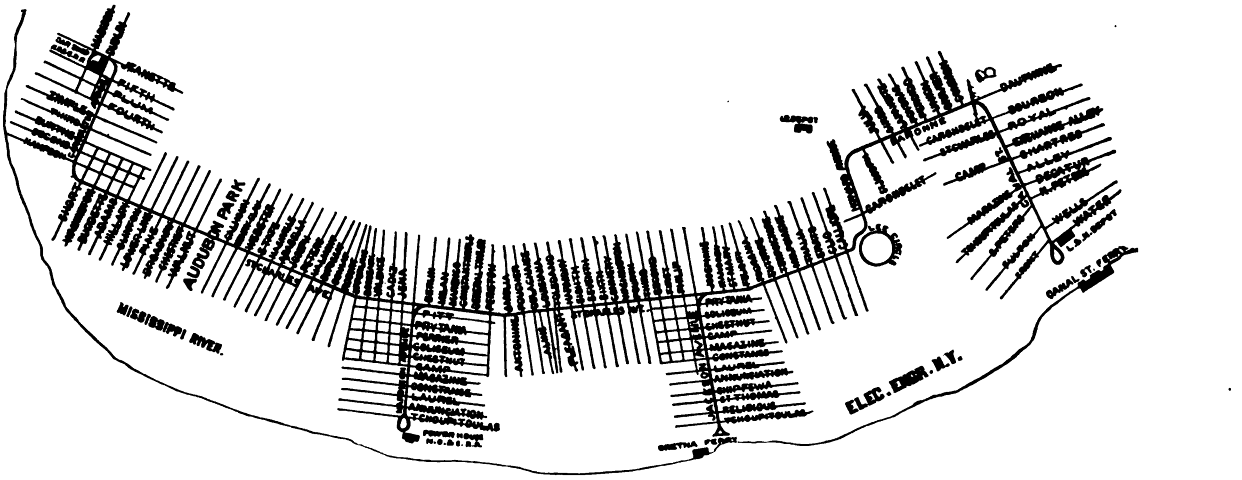


FIG. 1.—ROUTE OF THE ELECTRIC STREET CAR LINE, NEW ORLEANS.

It was years ago compelled to give up steam on account of the city growing around it, and has ever since realized the need of a much better motor than animal power. To this end the company has spent with great liberality, considerable money experimenting with every mechanical system that has been presented; electricity is the only exception, and this would have received due consideration much sooner if the company had been able to do so when electric traction was first brought out, as will be shown.

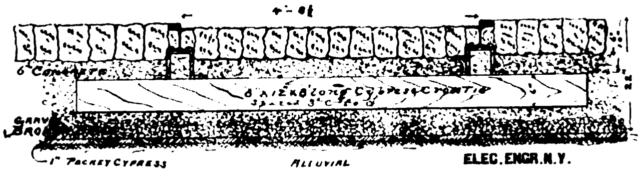


FIG. 2.—METHOD OF TRACK LAYING.

In 1867 an overhead cable system was tried, the cable being placed over the centre of the track on a frame structure and kept in motion by a stationary engine at one end, the grip being placed on top of the cars. On account of drainage being impossible here, an underground conduit could not have been constructed, and it is even doubtful whether it was thought of, as this is said to be one of the first, if not the very first, attempts at cable propulsion ever made.

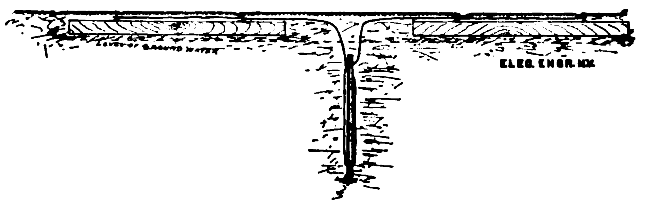


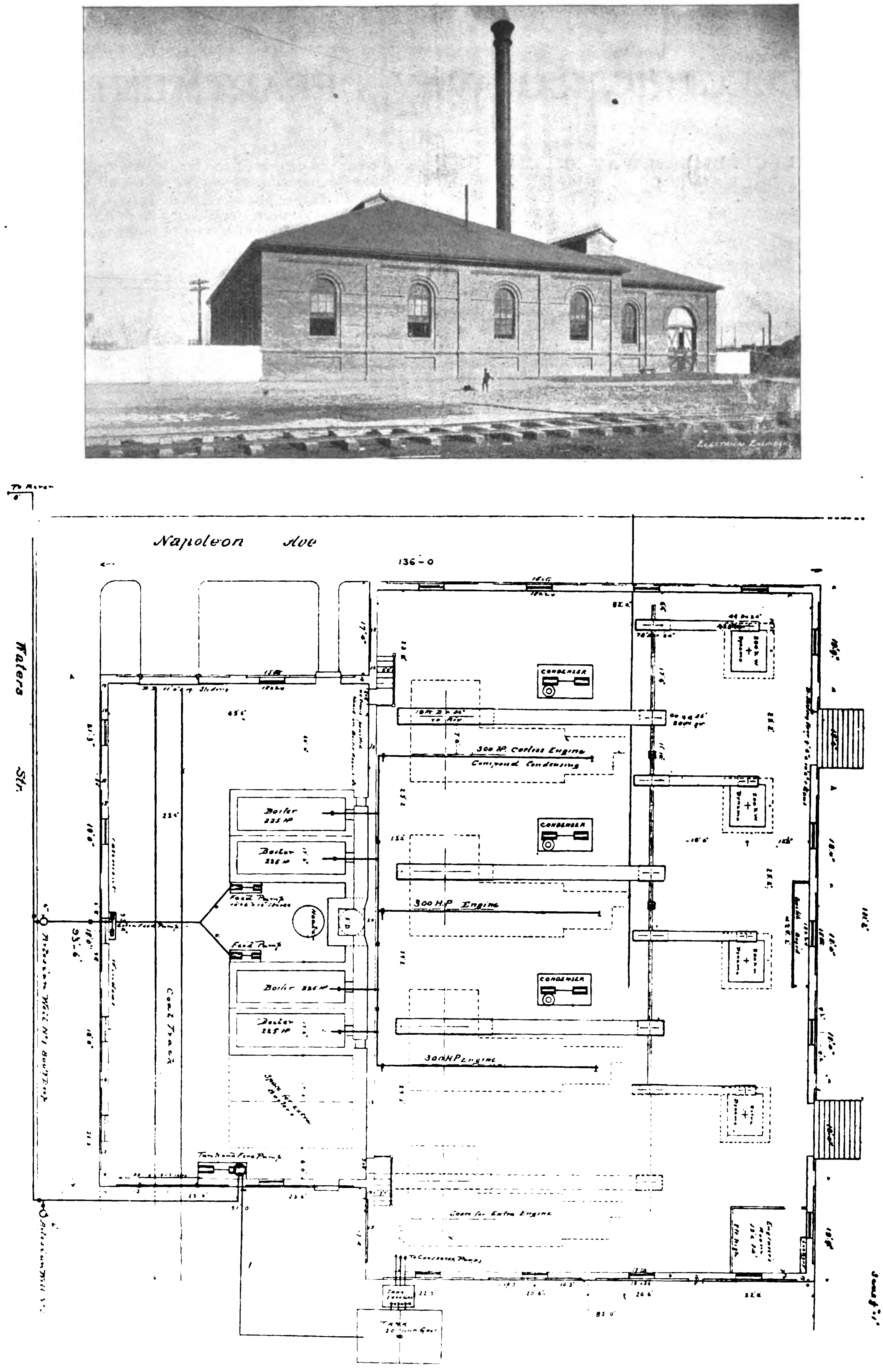
FIG. 3.—METHOD OF MAKING GROUND CONNECTION.

For three years (1872-1875) fireless locomotives, which were charged with steam from a station at the end of the line under a pressure of 200 lbs. per square inch, were tried and found unreliable even after a fire-box was placed under the boilers to keep the temperature up. Compressed air and ammonia were also tried in their turn. So the mule was again victorious and took his old place back, which he has held with honor and profit to his master, until at last he realizes that before the expiration of 1893 he will return to his original occupation of raising sugar and cotton.

Immediately upon the announcement five years ago that electricity had been made a success at Richmond, Va., for the propulsion of street cars, the management of the N. O. & C. R. R. Co. sent their superintendent, Mr. C. V. Haile, to Richmond, to investigate; his report was so favorable that the company determined at once to adopt it. Upon applying to the council for permission to make the change, the usual fight against the *deadly* (?) trolley was waged to such an extent as to defeat it.

In the meantime a company was formed here to develop the much-wished-for storage battery system. They determined to bide their time, with the hope that it would be a success, knowing full well that all the elements for its successful operation could be found in this city, as it can be truly said that this is a city of not only "magnificent distances," but of "magnificent *flatness*." At last, after several years' trial, and the loss of considerable money the inevitable came, and the storage cars had to be given up. Upon a renewal of the application in the early part of 1892, backed by a petition of the citizens on the line of the road, it was granted by the council.

The Directory immediately set to work to select a system and materials which were considered the best adapted to the peculiar conditions which exist in New Orleans. They now have in operation the plant and equipment to be here described. The work of



FIGS. 4 AND 5.—POWER HOUSE, NEW ORLEANS AND CARROLLTON RAILWAY; AND INTERIOR OF POWER HOUSE.

construction was commenced on July 13, 1892, by Mr. A. L. Abott, chairman of the Citizens' Committee, driving a silver spike. It was continued from this time through a very wet season with the river higher than it was ever known before, which broke the levees above the city and delayed the delivery of material, etc., for the power house, etc., by flooding the railroads. The road was opened for travel on Feb. 1st, 1893, with a public demonstration, and is now in successful operation.

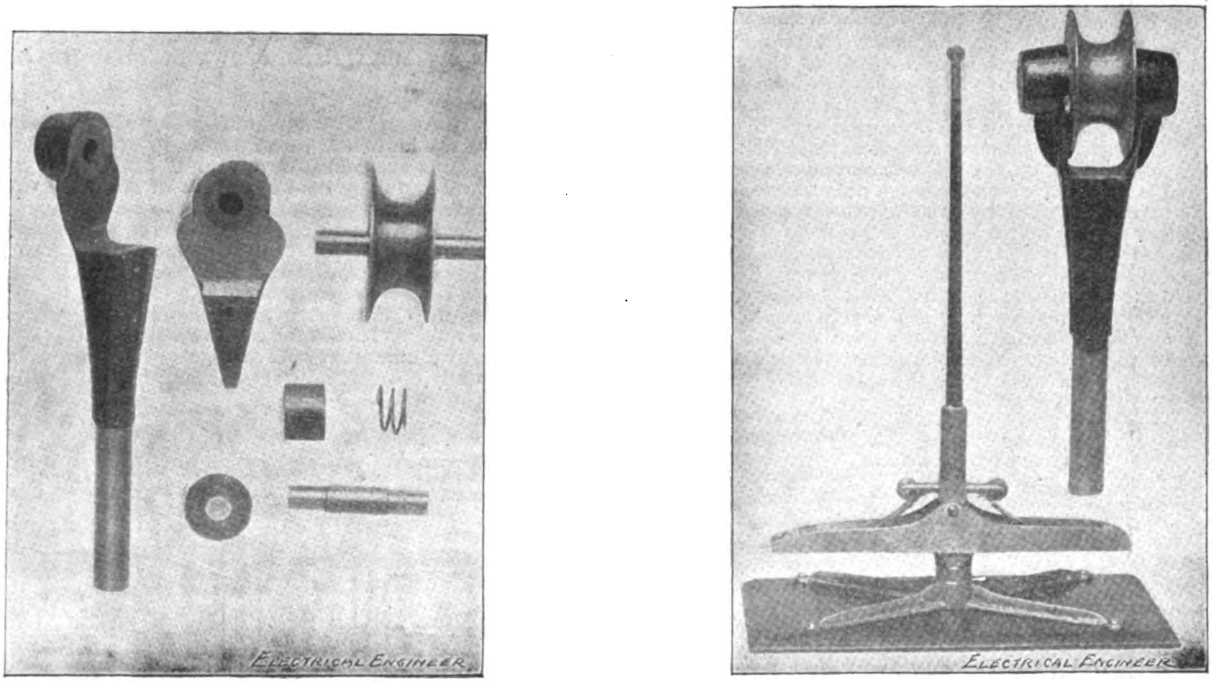
II.—THE ROUTE.

Commencing at Canal and Baronne streets for the present, the road passes up Baronne and around Lee Circle by a series of reverse curves; thence for about five miles up the centre of the wide and beautiful St. Charles avenue on a strip of parking called here "Neutral Ground," which is thirty-two feet wide, with a row of shade trees on each side for nearly the whole distance. This strip was originally the road's right-of-way and was condemned in 1833—through sugar plantations. At the end of St. Charles avenue the line turns off down Carrollton avenue for one mile to the end of the road, where are situated the offices, car house, and work shops. (Fig. 1.)

The Jackson street branch, a very important feeder, leaves the St. Charles avenue line about one and a half miles from Canal street, and extends for a mile to the river. The Napoleon avenue branch, two-thirds of a mile long, leaves the St. Charles avenue line about the middle, and goes to the river where is located the power-house. It is the intention for the line to run up Canal street to the river in the near future. All the lines are double-tracked and the total length of track now in operation, including the branches, is about 17 miles, with 4 feet 8½ inches gauge.

III.—THE TRACK.

As is well known, New Orleans is below the high-water mark of the Mississippi river by about eleven feet, the river being kept out by levees. The soil is alluvial, and under the above conditions water is easily found within 10 to 20 inches of the surface; this feature alone made it a very difficult problem, to decide upon the best method to secure a solid road bed. Fortunately a very fine quality of gravel was to be had from Rosetta, Miss., 130 miles distant, which cost about $4 per cubic yard delivered by railroad. After due consideration the following method was adopted for both the Johnson and the Duplex girder rail track, as shown by Fig. 2.



FIGS. 1 AND 2.—THE ALLEN TROLLEY FOR ELECTRIC CARS.

The excavation for the foundation of the road-bed was made twenty-two (22) inches to sub-grade, the water pumped out, and the bottom floored over with one (1) inch cypress plank; on this floor was placed from four (4) to five (5) inches of old broken brick. Extra wide sawed cypress cross ties eight (8) feet long twelve (12) inches wide and six (6) inches thick were then placed in position, the rails laid, and tamped to grade with Rosetta gravel.

The paving will consist of either Belgian or asphalt, on six inches of concrete. There are only about 8,000 feet of double-track of girder rail, 70 lbs. Johnson, and 66 lbs. Duplex.

The principal part of the road being on the "Neutral Ground," regular railroad construction was used with 50 lb. T-rail on 7 x 9 x 8 inches long-heart cypress cross-ties, spaced twenty (20) inches from centre to centre, and ballasted with the natural soil, and a few lake shells, that had served as ballast for the old track. It is hoped by the Directory, with good drainage and careful attention, that they will be able to keep this track up, under the heavy travel that it is subjected to.

IV.—THE LINE.

Walworth iron double-bracket centre-poles with 6, 5 and 4-inch sections are used on the "Neutral Ground," where the tracks are spaced 8 feet apart. On Jackson and Baronne streets (the paved streets), iron side poles are used. All poles are set 7 feet in Portland cement concrete. No. 0 hard-drawn copper trolley wire is used; rail-bonds No. 0 tinned copper wire, with channel pins.

At every three hundred (300) feet and between the tracks is buried a ground plate, made of a piece of old rail about eight feet long, with a wire passing through holes in the top and bottom, and plugged with channel pins. Each end is connected to the two rails on each side, thus cross-connecting the tracks. These plates were sunk with a post-hole digger so that the top end would be below the water line. The method adopted is illustrated in Fig. 3. Where the line passed over drainage canals, old rails were placed in the bottom, and cross-connected at each end to both tracks.

The General Electric Company's line material was used throughout. Eight No. 0000 and one No. 00 feed wires are used, having an aggregate length of 30 miles.

V.—THE POWER HOUSE.

The power house is situated at the head of the Napoleon avenue branch, near the Mississippi river, about three thousand feet from the main line at St. Charles avenue, and practically in the centre of the system. It is constructed of red brick laid in Portland cement mortar throughout. (Fig. 4.)

The foundations of the side walls rest on two crossed layers of 8 x 12 inches cypress, calculated to sustain with safety 1,000 pounds per square foot. The whole building is covered with slate, on steel roof trusses. Fig. 5 shows the dimensions and arrangements.

THE ALLEN TROLLEY.

FEW persons, even among electric railway people, have ever stopped to inquire into the history of the trolley, and yet there is hardly a single detail of the electric car which has had a more varied and interesting development. Even at the present time marked improvements are being made and one of the most noteworthy in this field is that known as the Allen trolley.

As is well known, the greatest trouble found in the usual form of trolley is the bushing in the wheels wearing out very fast—on an average they must be rebushed once a month—besides requiring oil once a day and constant attention. The Allen trolley overcomes these difficulties, and by employing the construction shown in Fig. 2, and in detail in Fig. 1.

In the first place the bearings are made of Holmes' fibre graphite and hence require no oil whatever. They are fastened in each side of the yoke and the pin or shaft is fastened to the wheel, both revolving on the bearings in the yoke. This makes the trolley mechanically correct and thereby avoids all wobbling of wheel, as it is compelled always to run steady and true.

Another valuable feature about the Allen trolley is the springs, which are spiral, and kept inside the wheel, being held in place by a brass washer. Thus the springs are unable to get out of place, and must constantly keep up the same contact, thereby avoiding any break or arcing of the current, and as the wheel runs steady there can be no rattle.

Instead of the usual accumulation of oil, grease and dirt on the top of the car, caused by the oil splashing down from the trolley, the car and rope are clean. During a recent test an Allen trolley wheel ran 900 miles without showing appreciable wear. The Allen trolley is manufactured by the Allen Trolley Company, of 123 North Third street, Philadelphia, Pa.

THE O'NEILL-BROWN SYSTEM OF ELECTRIC HEATING.

The problem of heating by electricity is one which has attracted the attention of electrical engineers for the past few years, especially as applied to the heating of spaces, chambers or street cars. Not much has been attempted in the way of heating buildings or rooms, but a vast deal of energy has been applied in the attempts to heat electric cars by means of the electricity which is the source of their own propelling power. The ordinary car stove has never been accepted as an ideal heater, however economical it may be, for very apparent reasons. It vitiates the air, is not clean, occupies a considerable space, and requires a large amount of attention on the part of the conductor. Electric heating is looked upon as the most promising method of the future, and much time and ingenuity have been applied in developing various electric heaters. That the heaters heretofore in use have not been more universally adopted has been attributed to their lack of economy. The heating system described in this article is totally unlike any other now on the market, embraces absolutely new theories, and is a system which heats not only economically, but which will distribute and preserve the heat units generated. The various heating devices on the market depend on the heating of high resistance wire by a current of electricity, which heat is at once dissipated into the surrounding atmosphere. The system of the Standard Electric Heat, Light and Power Company, of Boston, on the contrary, while the heat is also generated originally by current passing through high resistance wire, does not allow it to be dissipated into the atmosphere, but conserves or stores it in a generator placed out of sight under the seats of the car, and then distributes it by a system of pipes containing a chemical liquid of high latent heat, which is heated in the generator, and which heats the car uniformly by radiation and diffusion.

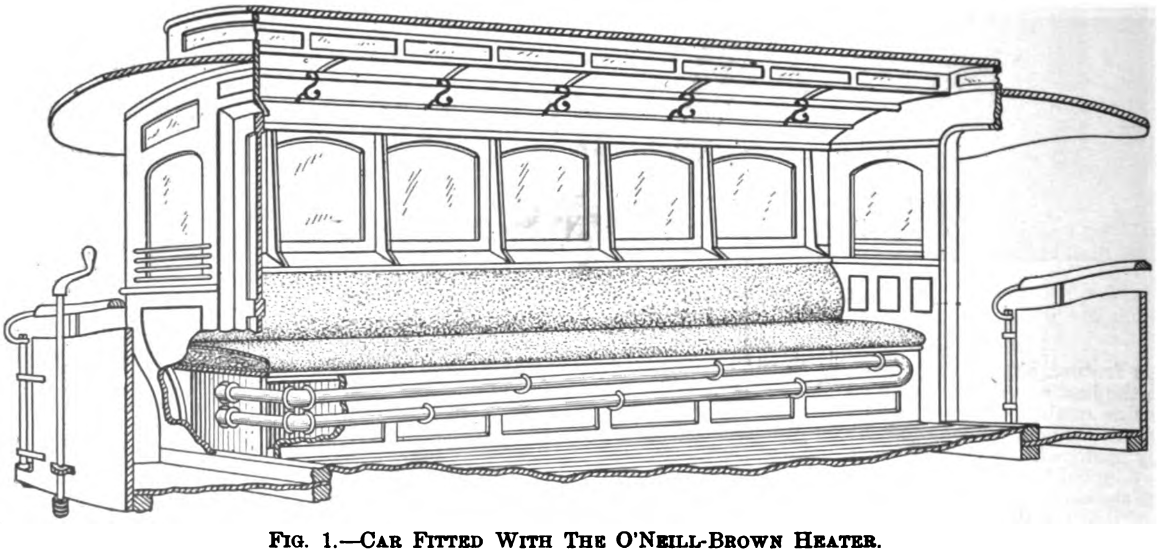


Fig. 1.—Car Fitted With The O'Neill-Brown Heater.

The accompanying diagrams show clearly the system. Fig. 1 shows an ordinary electric street car equipped with this system, in one corner of which will be seen the generator situated under the seat, and from which proceed the two pipes, attached to the panels of the seats, through which the hot liquid circulates. Fig. 2 shows the generator which produces the heat, and which contains the liquid and the electrical apparatus. The heat is developed within this generator through resistance and hysteresis, a wire of special alloy with inductive windings being imbedded in a somewhat remarkable compound, possessing contradictory qualities; for while it radiates heat even more than iron, it at the same time possesses extraordinary storage qualities, retaining the heat for at least two hours after the current has been withdrawn. This apparatus is in the form of a wedge-shaped block, and rests within two insulated heating chambers within the generator. Around these chambers, and surrounding them on all sides is the chemical compound, contained within the outer casting, presented in thin layers to a large heating surface, so that the absorption of heat units is great and instantaneous. The co-efficient of resistance of the alloy used within this electrical apparatus is constant under all temperatures, and thus a uniform high temperature may be maintained with an unvarying current strength. The chemical compound employed as a medium of circulation has the highest known co-efficient of latent heat giving the advantage of thermal storage that is utilized in keeping the street car heated during the busy hours of the day, when heavy traffic demands tax the generators in the power house to their uttermost, and no current can be spared for other than traction purposes. This same property of high latent heat also precludes the possibility of the pipes being destroyed by the freezing of the liquid, when the car is not in use, it being able to withstand a temperature of 56° Fah. below zero.

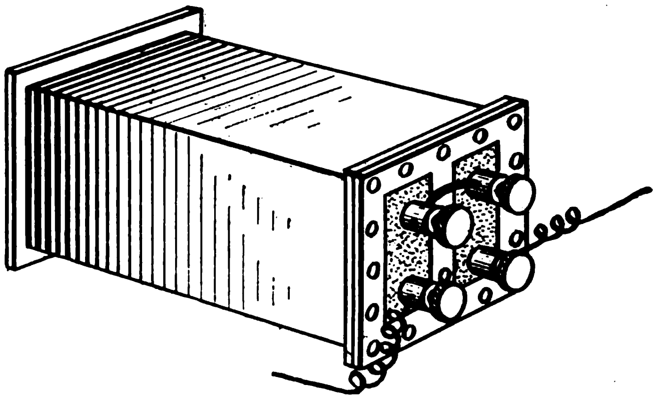


Fig. 2.—The O'Neill-Brown Electric Heater.

That the effects claimed for this system are amply borne out, are proved by a numerous series of tests which have been made on cars in daily operation for several months past, with the result that with an average outlay of energy of 1 h. p. an inside temperature of 60° has been maintained under all weather conditions.

The resistance of the electric apparatus being 250 ohms, it follows that the average current at 500 volts is two amperes, but as this current is used intermittently, the electrical apparatus in the car running first under current and then under storage, the average current consumed is about *one ampere*. Since, however the barometric and hydrometric conditions of the atmosphere have to be considered, it may be fairly stated that an average of 1 h. p. (which is more than one ampere at 500 volts) is more than sufficient to heat the car. This is a result which has never before been approached and is only accomplished by the O'Neil-Brown system, by its radical departure from all known systems, and owing to its peculiar generation, storage properties, and the system of distribution, which takes advantage of the properties of diffusion, every cubic foot of air in the car receiving simultaneously its own heat units. When it is considered that in a 30-foot car there are contained 1,000 cubic feet of air, that the air is constantly changing, owing to the opening and shutting of the doors, and that yet the temperature of the car is uniformly maintained at 60° Fah. in all weathers, it will be conceded by all who have given the subject of car heating any thought that these results are really remarkable.

The question of cost will naturally vary in each locality, according to circumstances governing the cost of horse-power, but it may be safely stated that it will in all cases be cheaper than the cost of heating by stoves. It will be at once admitted that even with the current of two amperes constantly applied, this system is extremely economical, but it must be borne in mind that the *storage* properties both of the generator and the liquid, are the source of the wonderful economy shown in the system, and the real secret of its success. In proof of this, in a recent test, a car heated by this system started out at two o'clock, the inside temperature being 65° and and the outside 23°, running in regular service, both front and back doors opening continuously, and at the end of 3 hours and 30 minutes, *with no current on during the whole of that period*, the inside temperature had only fallen off seven degrees, while the outside temperature remained practically constant.

This system is equally applicable to the heating of houses, conservatories and public buildings, and is now being demonstrated in actual practice in Boston.

The system comprising the various patents of Mr. Henry G. O'Neill, the inventor, is owned and controlled by the Standard Electric Heat, Light and Power Company, of Boston, which is composed of prominent Boston capitalists and of which Mr. Robert J. Edwards is president, and Mr. Frank Q. Brown, vice-president and treasurer.

WORLD'S FAIR DEPARTMENT.

THE PRESENT APPEARANCE OF THE ELECTRICITY BUILDING.

BEARING in view the fact that the World's Fair is supposed to be in running order on the first day of next month,—May—the present aspect of the buildings and grounds is not particularly cheering. Work is going merrily forward in all departments, the strike, which took 5,000 men from their posts on Monday, has been amicably settled and all hands are doing their best to present some sort of a showing on the 1st of May.

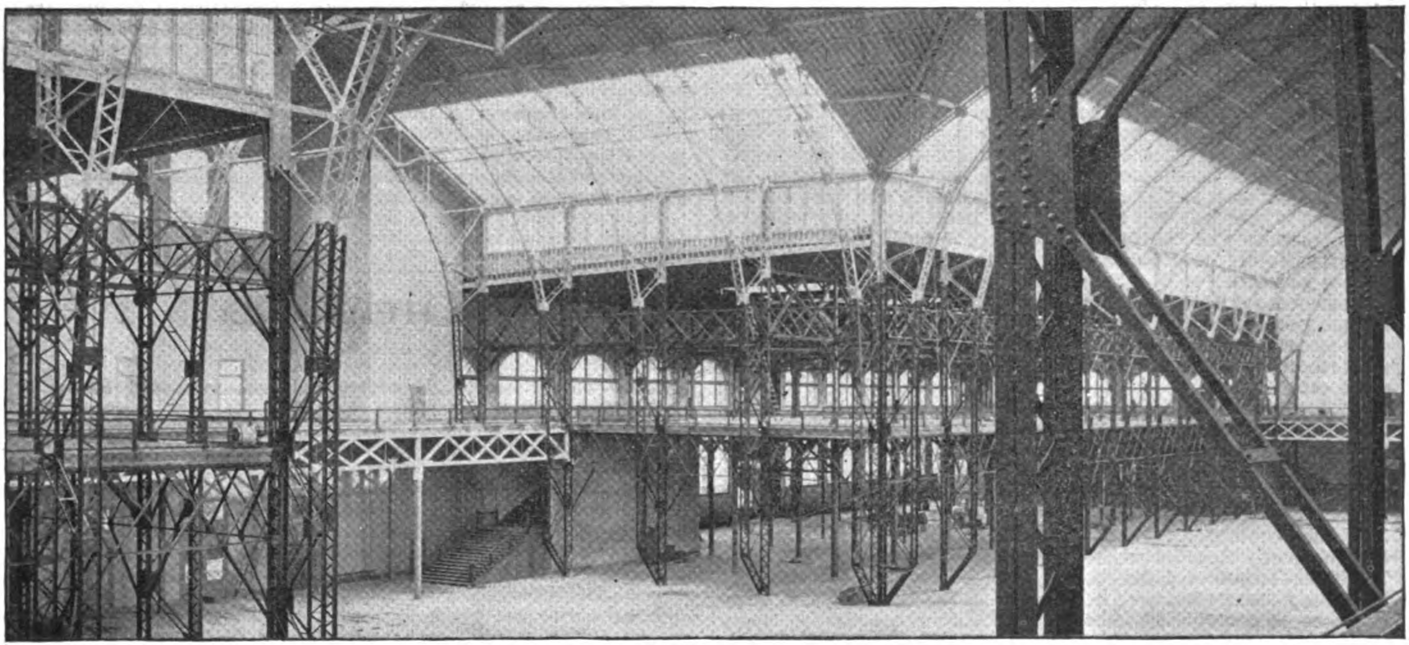
The general impression received by one on entering the Electricity Building is of an enormous carpenter shop. Cases opened and unopened, principally the latter, are strewn all about. Men are laying floors, erecting partitions and doing all manner of joiner work, while here and there electrical machinery is being set up and wiring is being done.

At present one entering the building sees little that can as yet be called an exhibit. Directly in front of the main entrance the classic temple of the Bell Telephone Company stands out prominently amongst the general confusion and is just receiving its marble roof—made of canvas.

Next to the temple comes part of the Westinghouse exhibit and beyond that the railway apparatus of the General Electric Company. Next to this the Tower of Light is being built. The frame work is only about half up at present so no very good idea of its effect when lighted can be formed. After this comes the Edison part of the General Electric display, then more Westinghouse and at the further, or north end of the building, Frenchmen are getting ready to show what they have done in electricity.

On the right hand side, looking north, under the balcony is the Western Electric Company. Then comes more Westinghouse, followed by the alternating current machinery of the General Electric Company, and finally, Germany. On the left comes first the structure of the Brush Electric Company, then the Fort Wayne Electric Company, the General Electric offices and their mining and motor exhibit. Beyond this is England and then France again. On the right of the gallery are at present Day's Kerite, the electric smelting machinery of Alfred Guillaume, the Strowger telephone, the Chicago Electric Wire Company of Delaware, the Norwich Insulated Wire Company, more Germany and the Ansonia Electric Company, while opposite these are the Electric Appliance Company, Chas. F. Hall, the H. W. Johns Company, Brazil, with an exhibit of government telegraphic apparatus and the Commercial Cable Company.

Scattered all over the building between and on every side of these exhibits are the empty spaces to be occupied by the rest, on some of which work is even now being done but has not advanced sufficiently to attract the eye.



GROUND FLOOR OF ELECTRICITY BUILDING, CLEARED FOR THE ARRANGING OF EXHIBITS AND NOW BEING FILLED UP.

LETTERS TO THE EDITOR.

THE BROWN SINGLE-PHASE ALTERNATE-CURRENT MOTOR.

SINCE the appearance of my article on single-phase alternate-current motors, some little correspondence on the subject has arisen, to which I now beg to submit the following answer. I should have written before this, but I have been for some time absent from Baden, and I also wished to give time for the other side of the question to be fully stated before replying.

On reading the various letters, I was really amused to notice how that, after the publication of the particulars of my motor, everyone has suddenly discovered that he invented it himself long ago. I can only remark, and I imagine that most readers of the correspondence will agree with me, that, had any of these motors come within measurable distance of a solution of the problem they would long ere this have come into general use. Prof. Elihu Thomson claims to have produced such a motor in November, 1888, and Messrs. Hutin and Leblanc had as early as May, 1891, so complete an insight into the underlying principles of the problem as to write an elaborate mathematical article upon the subject. In neither of these cases, nor in that of Mr. Tesla, who also worked in the same direction, was there any lack of capital to assist in bringing the motors before the public; yet, although in each case ample time has elapsed, the machines have not come into use in practice, in spite of the fact that there has always been a great demand for a self-starting alternate-current motor without a commutator. I have no wish to underestimate the importance of the work done by Prof. Thomson, Mr. Tesla, and other early workers in the field, but I would point out that certain points in their machines were inherently defective, and that it was only by remedying these that I have succeeded in producing a practical single-phase motor. As some further elucidation seems to be necessary, I will describe more exactly the points in which my motor differs from the earlier ones, and to which I attribute its success.

From the published figures and descriptions of the motors of Thomson, Tesla, and Leblanc, it is apparent that the arrangement and winding of the magnetic circuit, both in the fixed and rotating parts is suitable only for synchronous working, the number of poles and windings being the same in both. It will also be noted that all the above-mentioned motors have very sharply-projecting poles, so that the magnetic resistance varies according to the position of the rotating part with regard to the fixed. The result of this will be that the former will have certain positions in which it will tend to place itself, and only when in these positions can currents be properly induced in it. Such a motor can only give power when running synchronously, and cannot be started with a two-phase current, even if of exactly 90 deg. phase-difference as produced from a two-phase machine except, perhaps, with very low periodicities, and even then without appreciable torque. In fact, in most cases the motor will only run if first brought up to almost synchronous running by some external means.

In the motor described in my article, on the other hand, there is no correspondence whatever between the winding or form of the magnetic circuit in the outer inducing and inner induced parts. On the contrary, they are, and must be, completely different from one another. It will also be observed that there are no sharply-projecting poles, but that the inducing winding is carried in a large number of holes which are uniformly distributed over the whole surface of the iron. The short-circuited induced winding is also carried in holes uniformly distributed over the surface of the rotating part. The numbers of holes in the induced and inducing parts respectively must have no common factor. The result of this arrangement is that when a single-phase current is sent through the outer or inducing winding, the inner part has no tendency to place itself in any particular position. If, in such a system, a second current is employed, as more exactly described by me in my article, having a difference of phase from the first, a turning moment is produced, the motor is started, and on reaching a certain speed this second current is cut out. The motor then runs up to a speed corresponding to its load, and only when running light will the speed approach synchronism. When loaded, the speed of the rotating part sinks so far below synchronism that the current produced by this difference of speed gives the necessary torque. The extent of this drop depends on the form of the rotating part, as explained in my former article. With regard to speed and armature current, the motor is, therefore, exactly analagous to a direct-current shunt-wound motor. The bedding of the winding in holes, as so often explained, is for the purpose of reducing the current required for the excitation and thus securing a high-plant efficiency. I would also point out that the weight efficiency of these motors is entirely dependent upon the proper choice of the various proportions. By suitable design, remarkably favorable results may be obtained. Thus I have now several 10-h. p. motors at work, giving this power at the low speed of 800 revolutions, with a weight of only 500 kilogrammes and the heating is practically *nil*. As a matter of fact, one of these has been at work (in a saw-mill at Ragaz) day after day giving over 15 h. p. with moderate heating and has even been braked to 20 h. p. without pulling it up. Preliminary experiments show that the motor has a commercial efficiency of 88 to 90 per cent., the apparent watts being only about 12 per cent. in excess of the real watts. I must not omit to mention that this motor has no sliding contacts, and had sufficient starting torque to set in motion a line of shafting.

With regard to the letter from Herr Arnold, which appeared in several technical journals, I can simply state that the development of my motor dates from 1891, as stated in my article, and that after definitely settling all details I also applied for patents. Unfortunately, I was sufficiently incautious to explain my improvements to various interested people, so that the secret more or less leaked out. In his letter Herr Arnold attempts to treat the motor as a mere copy of those of Tesla and Thomson —whether from ignorance or design I am unable to say.

With regard to the letter of Messrs. Hutin and Leblanc, claiming priority in the invention of the motor in its essential principles, I would only say that from an examination of the French patent specification No. 204,456, it may be seen to be a two-phase motor of the Tesla type, the two phases being produced either from a special generator or by splitting the original current by means of a condenser which is always kept in circuit. Judging from my own experience, I must rather doubt if this motor would start even with two-phase current of 90°-phase difference, as the whole design points to synchronous working.

Referring to the American patent No. 487,633 mentioned by Prof. Elihu Thomson, I find no trace of the principle which he so prettily illustrates at the end of his letter, but which is, on the other hand, the principle of my motor. He shows a motor having sharply-projecting poles and corresponding windings both on the fixed and rotating parts, and he specially mentions in his specification that the number of poles in both parts must be the same, thus producing, as mentioned above, a synchronous non-starting motor. If, as Prof. Thomson says, he could have made these motors work successfully at low periodicities, and was only prevented from introducing them into general use by the high frequencies in vogue in America, I would only point out that there was nothing to prevent the adoption of a lower frequency in the then early stage of development of the alternate-current system, especially when we remember that now, after an immense number of high-frequency plants have been installed, American practice is beginning to come down to lower frequencies. It seems incredible that Prof. Thomson could have been short-sighted enough not to have seen the enormous importance of the practical development of such a motor.

C. E. L. BROWN.

BADEN, SWITZERLAND.

LITERATURE.

Twenty-fourth Annual Report of the (Massachusetts) Board of Railroad Commissioners. (Pub. Doc. No. 14). Boston, 1893.

EACH successive annual issue of the report of the Massachusetts Railroad Commissioners devotes an increased amount of space to the consideration of questions arising from the use of electricity as a motive power for street-railways. In New England at least steam-railway practice, having practically become standardized, little remains to be done by the commissioners, beyond passing upon the application of well-established general principles to particular cases. The introduction of electricity has not only involved new dangers to life and property, but has given rise to a wholly new set of administrative problems, some of them of a most serious nature, in the meeting and solving of which precedents can, at best be of but little value. These conditions, of course, exist in a greater or less degree, wherever the electric railway has been introduced, but we believe the Massachusetts Commissioners are entitled to the credit of being among the first, if not the very first, to grapple with the subject in a courageous, and at the same time in a candid and intelligent spirit.

In their general discussion of the subject, the Commissioners say that in their judgment the time has come for the legislature to consider what place the electric railway is henceforth to occupy in the economy of public travel, and under what regulations it is to exist and develop. The report says:—

> "If it is to continue to occupy the same place that the horse-railway has occupied for nearly 40 years, with change in part or in whole of motive power only, that is one thing. If it is to duplicate the railroad system of the state, using the public highways for the construction of another co-extensive system of trunk and branch railway lines, that is quite another thing; and the laws and regulations which have been made for the one case will be found inadequate for the other."

The horse car, in its original inception was nothing more than an improved omnibus, and hence, like the omnibus, the cab, and the hackney coach, naturally fell under the control and supervision of the municipal authorities charged with the supervision of the public ways. A general act, passed in 1864 for the regulation of such companies, provided that such motive-power might be used within the limits of any municipality as the authorities thereof might from time to time permit, and this provision for a quarter of a century, proved to be adequate and sufficient. But the introduction of electric power has wrought a radical change, not only in the character and practical working of the street-railway, but in its very idea and purpose. It is no longer merely a local enterprise, built by home capital, and managed by persons whose interests are identified with those of the community which it serves, and having no ambition beyond that of furnishing an additional and needful facility for city and town travel. Extending itself out into trunk lines connecting comparatively remote centres of commerce and population, it is rapidly assuming the functions and undertaking to compete for the traffic of the old-established steam railway lines. To a large and increasing extent, moreover, these enterprises are passing under the control and management of powerful aggregations of capital, and become available as a basis for the issue of stocks and other securities to an amount largely in excess of that actually paid for the plant, and upon which the public using the railways are expected to pay a return.

Notwithstanding this radical revolution which has been wrought in the purposes and methods of the street railway, it is a fact, as the commissioners take pains to point out, that the electric railway of to-day, in so far as it is regulated at all, is regulated only by a code of laws framed wholly with reference to the requirements of horse car transportation. The law-making power of the Commonwealth has as yet failed to recognize that with the general introduction of electric power, the street-railway has undergone a complete transformation, by reason of which it has come in all essential respects to bear a closer resemblance to the steam railroad, than to the horse railway. If the future province of the electric railway is to be in great part, as a competitor of the steam railway for suburban and interurban traffic, nothing can be more certain than that in the near future it will demand the privilege (it exercises the right already in some places) of transporting merchandise as well as passengers, and a permissible speed approaching that of the steam-driven train. It is therefore a question for the legislature to decide—and the decision ought not to be long delayed—whether the free use of the highways of the Commonwealth is to be conceded to the electric railway for inter-town, inter-city and inter-state transportation, without further limitation or regulation, or under what limitations and regulations it shall be done.

With reference to the financial aspects of the question, a number of salutary recommendations are made to the legislature by the Commissioners. The general railroad law now requires an amount of capital equal to at least 50 per cent. of the estimated cost of construction to be actually subscribed by responsible parties, before any steam-railroad, or any branch or extension of such road, can be built. In view of the known cost of construction of a modern electric line, the amount now required to be subscribed is absurdly small, being only $2,500 per mile for lines outside of incorporated cities, and hence it is recommended that the provisions of the steam-railroad law be extended to street-railways also. It appears, moreover, that there is now no limitation whatever upon the total amount of mortgage bonds which a street railway may issue, although there would seem to be far more reason for such a limitation in the case of a corporation which only holds its location and roadway at the will and pleasure of the municipal authorities of a city or town, who may order them removed without liability for damages or compensation, than in the case of one which holds its location, road-bed and tracks in fee-simple. The Commissioners wisely recommend such legislation as shall compel the owners of a street-railway to contribute at least as much cash to the enterprise as they ask the public to lend or invest in its aid.

Referring to the question of grade crossings, the Commissioners call attention to the fact that it has been found necessary, for the safety of public travel, to regulate by legislation the conditions under which railroads shall cross at grade public ways, and other railroads, and to make provision for suitable safeguards by which the dangers incident to road crossings may as far as possible be avoided, and they accordingly urge that similar legislative provision be made with reference to the crossing of steam and electric railroad lines. The report says:

> "The people of this state, after long and patient endurance, woke up some years ago to the absolute and immediate necessity of getting rid of the grade-crossings of railroads with public highways. It is seriously to be feared, or rather it may surely be expected, that the admission and multiplication of electric railways upon the streets and thoroughfares of the commonwealth will be found at no distant day to have entailed upon the general public annoyances and dangers not different in kind, and greater in the aggregate, than those suffered from the railroad grade-crossings which are now in tedious and costly process of abolition."

There have already been several very narrow escapes from serious disasters at some of these crossings, but, nevertheless, in the absence of restrictive legislation, they are increasing with ominous rapidity. In a recent hearing on the subject, it was stated that there were forty such crossings on the Boston & Maine system, and twenty-two on the Old Colony.

During the year ending September 30, 1892, the number of miles run by electric cars was 8,510,283, and by horse cars 8,088,377. The number of persons injured on the street was twenty by horse cars, and twenty-nine by electric cars. The commissioners remark that on the whole, the record of accidents on the West End Street Railway of Boston, compares very favorably with that of the steam railroads. Considering the hourly passage of hundreds of cars through crowded streets, and the carelessness of hurrying foot-passengers, it is certainly surprising, not that there are so many, but that there are so few accidents.

The total length of street railway track, including double track and sidings, September 30, 1892, was 814.36 miles, an increase of 140.28 miles for the year. Of this total, 492.30 miles are operated wholly or in part by electric power, and 322.06 by horse-power, an increase, as compared with the previous year of 203.28 miles equipped for electric power, and a decrease of 63.05 miles equipped for horse-power. The economy of electric traction is made evident by the fact that the average profit per passenger over the preceding year has risen from 1.01 cents to 1.22 cents, and the average profit per round trip from 45 to 56 cents. The net income of all the companies amounted to 6.11 per cent. on the aggregate of their capital stock and gross indebtedness, which is by no means a bad showing, all circumstances considered.

The report is signed by John E. Sanford, Everett A. Stevens and William J. Dale, Jr., commissioners.

F. L. P.

THE BUDA-PEST TELEPHONIC NEWSPAPER.

The cable dispatch of the New York *Sun* of April 8, says:—"The fortunes of the telephonic newspaper of Buda-Pest are full of difficulties. Several persons who complain of being telephonically libelled have brought suits against the projectors of the enterprise. Hungarian lawyers are now struggling with the problem whether libels by telephone are actionable. The Government also regards the experiment with disfavor because of the difficulty of exercising the power of censorship scientifically. However, the scheme has been a complete success. There are now subscribers in every town in Hungary possessing the telephonic system. One transmission enables every subscriber to hear the editorial voice with perfect ease. The electricians in charge say that if there were a half million subscribers scattered all over Europe each one would hear distinctly the voice of the editor in Buda-Pest. Unfortunately the inventor of the system and founder of the enterprise, Theodor Puskas, died a fortnight ago. He was a real genius. He introduced the Telephone Exchange in Paris, and was well known to the electricians of the world. For a long time he was a disciple of Edison, at Menlo Park. His principal invention, of which the telephonic newspaper at Buda-Pest was the first great application, was a device by means of which the human voice is carried over an unlimited number of circuits to all points of the compass. The newspaper is now being conducted by the inventor's brother."

IMPORTANT ELECTRIC RAILWAY LEGISLATION IN CONNECTICUT.

A special dispatch from New Haven of April 13, to the *Evening Post* says:—The long struggle over the question of regulating the building and control of the myriad electric roads projected in this state has resulted in a general electric railroad bill reported unanimously at Hartford by the joint Committee on Cities and Boroughs. The bill fills 15 typewritten pages.

It provides for large control of such enterprises by the cities, boroughs, and towns, to whose officers must be submitted for approval plans in regard to layout, motive power, track, and equipment. Construction must be supervised by local officers. Charter rights expire with the second General Assembly after granting, provided the roads is not built in the meantime. The new roads must keep the space between the rails and two feet on each side in good repair as ordered by the local authorities. The seventh section reads as follows:

> Sec. 7. No street railway company shall transport merchandise or baggage other than such small packages or bundles as are carried by its passengers, but the Railroad Commissioners may authorize any transportation of merchandise under such regulations as they shall prescribe in the order authorizing such transportation, with power to change and modify such regulations.

The State Railroad Commission is given power as to sanctioning electric roads which parallel steam lines. No speed is to be allowed higher than fifteen miles an hour, and regulation of speed below that rate is left to the local authorities. The companies must make reports to the Railroad Commission, and the same body is given power to regulate interchange of traffic between roads. Provision is made for appeals to the courts from decisions of the Railroad Commissioners.

The bill is made up of several long bills introduced by representatives of various interests. The local control by towns is expected to satisfy the farmers and protect their country highways, while the Consolidated Road is obviously favored by the limitations on speed, merchandise, and parallels. The unanimous report indicates that the electrical-railroad interests, which have a great lobby at Hartford, are also satisfied with the measure, which is almost sure to pass, probably without important amendments. The number of electrical-road bills before the Legislature is said to be more than one hundred, one corporation alone asking rights on no less than eighty streets and highways.

The bill, as it stands, will if made a law immensely enlarge both the powers and the labors of the present Railroad Commission of the State, and is not unlikely to lead to the addition of an electrical expert to that body, now made up by law of one civil engineer, one lawyer, and one "practical business man."

RECENT IMPROVEMENTS IN D'ARSONVAL GALVANOMETERS.—II.

BY NELSON H. GENUNG.

Turning our attention now to the movable system we find that when the coil is deflected from its position of equilibrium there is a torsional couple due to the suspension which tends to bring it back. This is the only directive force brought to bear on the system. The moment of this couple is a function of the angle of deflection, and may be made almost anything desired by varying the length and cross-section of the suspension wire. Aside from this directive force, there are various retardative forces at work when the coil is in motion due to the reaction of induced currents, friction with the air, and the like, which tend to bring the system to rest. These forces are functions of the angular velocity of the system.

In the movement of the coil of a galvanometer of this type we have an example of the rotation of a solid about an axis in which case the product of the angular acceleration by the moment of inertia of the movable system is equal to the sums of the moments due to the directive and retardative forces. The differential equation for the movement of the coil thus becomes

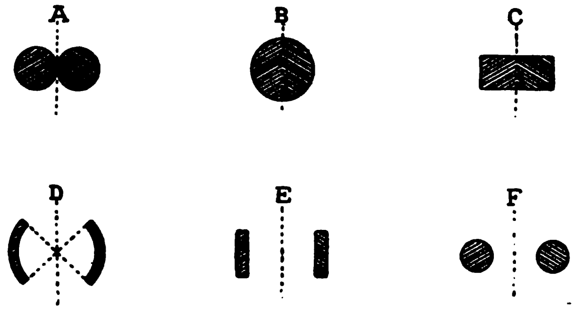


FIG. 7.

$$\Sigma\, m\, r^2 \frac{d^2\,\theta}{d\,t^2} + A\,\frac{d\,\theta}{d\,t} + B\,\theta = 0$$

in which θ represents the angular deflection in time t, $\Sigma\, m\, r^2$ the moment of inertia of the coil, A a constant for the retardative forces and B a constant for the torsional couple.

Imagine now the retardative forces to become negligible, the coil, when set in motion, acquires the same velocity every time it passes its position of equilibrium and makes a series of perfectly identical oscillations. It is thus said to have a *periodic* movement.

If, now, B is left constant and A made to increase gradually, the period becomes greater and greater as the logarithmic decrement increases. Finally, A having attained a considerable value, due to self-induction in this case, the coil on being drawn to one side and released, returns to its position of equilibrium, moving rapidly at first, then more and more slowly, finally coming to rest. Infinite time is required theoretically for accomplishing this; practically, however, the zero point is reached in the course of a few seconds.

Suppose the only damping effect on the needle to be that due to induction; A is then equal to

$$\frac{F^2\, S^2\, n^2}{R}$$

where F represents the strength of field; S, the area of the coil; n, the number of turns composing it, and R, the total resistance in circuit. Since the value of A depends on the total resistance R as the only variable, the field remaining constant it should become zero when R reaches infinity; that is, when the coil is on open circuit. As a matter of fact, however, A does not become zero quite, since the damping, due to friction with air, is not wholly negligible. By decreasing R the value of A increases and the coil finally assumes an *aperiodic* movement. A solid rotating about an axis is said to have an "aperiodic" movement when it takes up its new position immediately and without oscillation. By setting a d'Arsonval galvanometer coil of low resistance to oscillating on open circuit between the poles of a powerful horseshoe magnet, the transition from the periodic to the aperiodic movement is easily followed, as the circuit is closed through a high external resistance which is gradually reduced until the coil is short-circuited.

As early as 1881, Deprez[8] speaks of short-circuiting the coil for the purpose of damping the oscillations. The only resistance in circuit then being that due to the coil, the currents induced are sufficient to bring the needle slowly to rest. Ayrton and Mather[9] have encased the coil of their recently constructed d'Arsonval in a silver tube, which serves both as a damper and as a protection to the coil. The coil is rigidly attached to this tube, which forms a part of the movable system.

Apparently no particular attention was paid to the best form of coil to be used in d'Arsonval galvanometers at the time when the best shape of pole pieces was being so thoroughly studied. In a paper on galvanometers by Messrs. Ayrton, Mather and Sumpner,[10] the conclusion is drawn that the most sensitive galvanometer attainable is one of the d'Arsonval type suitably modified. For accomplishing this they say that the pole pieces should be very close together, the coil very small and no stationary iron core employed. The sensitiveness could be further increased by employing electromagnets instead of permanent ones. The coil should also be long and narrow and the controlling force reduced to a minimum whenever great sensibility is desired.

Mr. Mather,[11] a little later, presented a paper before the Physical Society, in which he exhibited the results of a thorough study on the best section of coil perpendicular to the axis of rotation. Quoting from this article: "Since for a constant period the controlling moment at unit angle must be proportional to the moment of inertia, the problem is to determine the shape of the section so that the ratio of the deflecting moment to the moment of inertia may be a maximum." The six sections shown in Fig. 7 are taken from the above-quoted article. In *A* the deflecting moment per unit moment of inertia is 1.02, in *B* it is .80, in *C* .97, in *D* .44, in *E* .47, and in *F* .40. Coil *A* is, as may be seen, more efficient than any of the others. These calculations are based on coils in which the length is great in proportion to the cross-section.

Suspension wires in a variety of sizes, shapes and materials have been employed at various times. Silver, platinum, silver-platinum, platinoid, German silver and phosphor-bronze are all materials for this purpose, the phosphor-bronze being on the whole the best, as it is little likely to corrode and is the least likely to take a permanent "set," thereby causing a slight change in the "zero point." The variation in sensibility due to the "time change," is also very small in the case of phosphor-bronze suspensions.

Flat strips possess a much smaller control than do round specimens of the same material having the same area of cross section. The liability to error due to a shifting of the "zero point," the result of a slight permanent "set," is much reduced by employing the strip. The radiation surface is at the same time considerably increased, this being often a matter of great importance in cases where very fine suspensions are necessary.

DEATHS AND ACCIDENTS CAUSED BY HIGH-TENSION CURRENTS.

M. D'ARSONVAL lately presented to the Biological Society the conclusions of an experiment made by M. Francis Biraud at M. Lacassagne's laboratory at Lyons. This work constitutes the first complete monograph published on the subject, thanks to the inquiries which MM. Lacassagne and Biraud made of electricians throughout the world. M. Biraud's study gives a very complete description of the fulguration accidents caused in the electrical industry, the relation of electrocutions practiced on men and animals in America, and, lastly, some experiences personal to the author. The conclusions deduced from these observations, moreover, agree remarkably with those M. D'Arsonval has formulated since 1887. Electricity appears to kill in two manners, as follows: 1. By producing mechanical lesions of the vessels and nervous system. 2. By inhibiting the great functions wholly or partically (stoppage of respiration, of the heart, of the exchanges between the tissues and the blood, etc). The first kind of death is especially due to the action of lightning and the static discharges of powerful batteries; in a word, it accompanies disruptive discharges. It is scarcely ever encountered in cases of industrial fulguration. The second, on the contrary, is nearly always the rule. From a practical point of view, these two kinds of death are distinguished in this sense, that the first brings about definitive death, while the second may only consist in a state of apparent death, from which the person may be made to revive by practising artificial respiration immediately after the accident. A person struck by lightning should be treated exactly the same as one drowned, according to the formula given by M. D'Arsonval to electricians, the application of which formula has called back to life a number of men since its publication. As to electrocution, it is, according to the opinion of MM. D'Arsonval and Biraud, a complicated, barbarous, and unreliable proceeding. M. D'Arsonval defies American doctors to practice artificial respiration after having electrocuted the criminal. Experience shows that an autopsy is a necessary aid in electrocution. Otherwise, he says, the use of dynamic electricity produces for the man a kind of anesthæsia, under cover of which he is mangled alive, and must be so in order to really become a corpse.

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[8] "New Deprez-d'Arsonval Astatic Galvanometer," by M. Deprez, *La Lumière Electrique*, September 7, 1881.

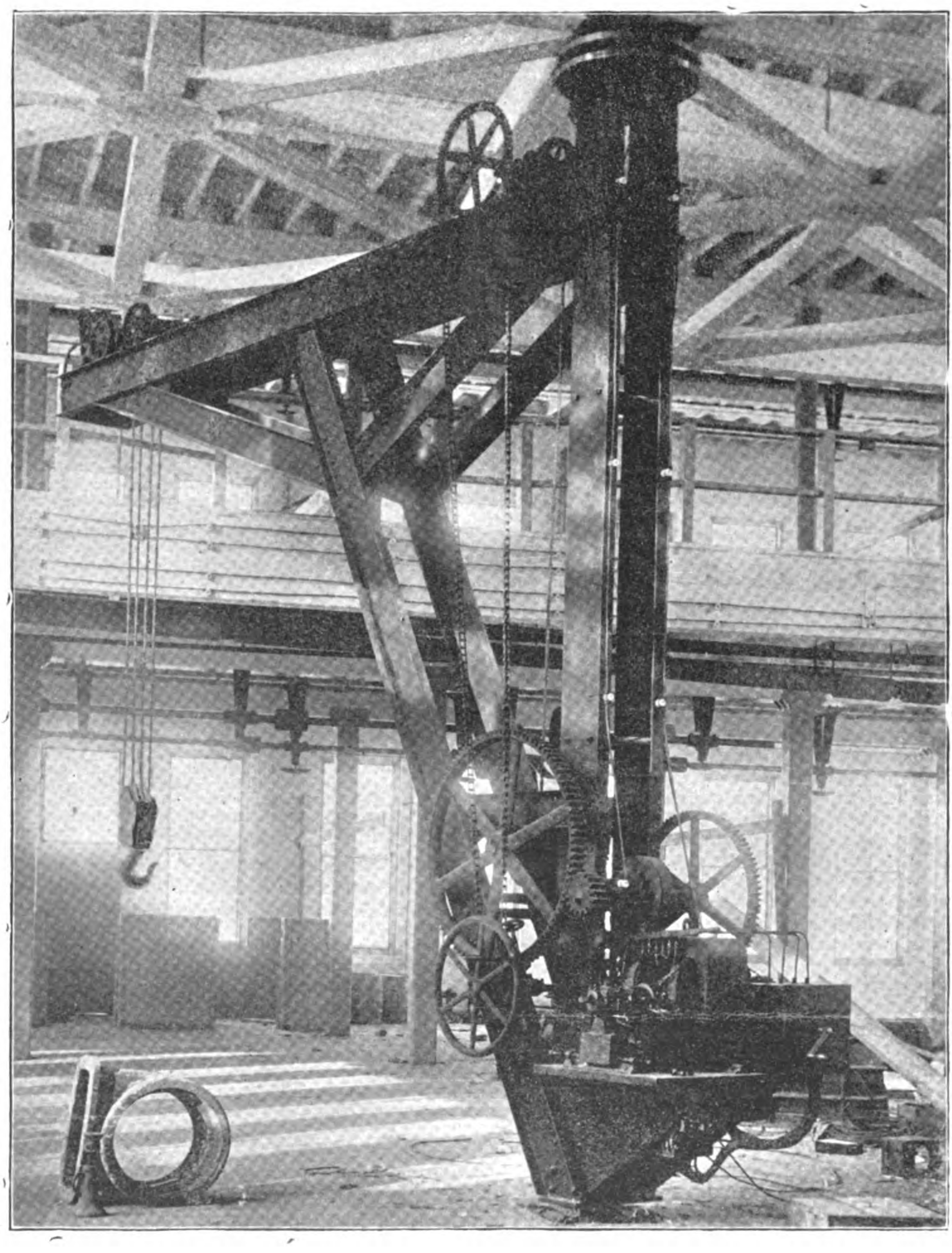
[9] "The Ayrton-Mather-d'Arsonval Galvanometer," *London Electrician*, July 29, 1892.

[10] "On Galvanometers," a Paper read before the Physical Society, *London Electrician*, February 7, 1890.

[11] *London Electrician*, April 11, 1890.

AN ELECTRIC JIB CRANE.

THE accompanying engraving shows a 10-ton jib crane which was recently put in the Michigan Brass and Iron Works, at Detroit, Michigan. Two of these cranes have been introduced, one having a capacity of five tons, and the one here illustrated, which as before stated has a capacity of 10 tons. These cranes are equipped with motors of 10 and 15 h. p. respectively, and drive the hoisting gear through cut spur-gears. The motors are specially fitted for crane use and are of the slow speed type, reversible, and the speed can be varied. The operator can easily control the movements of the load from the motor itself. A wire cable is used for hoisting and the racking is done by the hand wheel shown on the side of the crane near the base. The cranes are both so arranged that in case of accident they can be operated by hand power. These cranes were installed by the Detroit Foundry Equipment Company, of Detroit, which does a very extensive foundry outfitting business. The motors are built by the Detroit Electrical Works, and are series wound.



ELECTRIC JIB CRANE BUILT BY THE DETROIT FOUNDRY EQUIPMENT CO.

ELECTRICITY vs. STEAM.

THE recent performance of the Empire State Express of the New York Central, which ran at the rate of ninety-five miles an hour for ten consecutive miles, has greatly interested mechanical engineers and scientific men generally. This remarkable record is expected to have a very important bearing upon railroad schedules of the near future, and is especially interesting at this time, when extraordinary efforts are being made to reduce the time between distant points by means of electricity. Until lately eighty miles, or perhaps eighty-three, had been the fastest time made by any railroad, and this speed of ninety-five miles an hour by a complete train, weighing in the neighborhood of 200 tons, and running over different grades, throws new light upon the question of attainable speeds, and gives some data from which to work and figure for the future.

LEGAL NOTES.

THE DECISION IN THE "FEEDER AND MAIN" SUIT.

EDISON ELECTRIC LIGHT COMPANY *vs.* WESTINGHOUSE, CHURCH, KERR & CO.

THE decision in this case by Judge Green, of the U. S. Circuit Court, District of New Jersey, in favor of the Edison "main and feeder" patent has already been made known. The suit is familiar to readers of THE ELECTRICAL ENGINEER, and was brought under the patent No. 264,642, of September 19, 1882, for an "Electric Distribution and Translation System." The claims of this patent were given in full in the last issue of this journal. The infringement was alleged to have occurred in the plant installed at Trenton, N. J., under the first, second and third claims of the patent, all of which, as will be remembered, relate specifically to the maintenance of equal potential in incandescent lighting and of uniform candle-power of the lamps, on the mains of a central station, through the use of feeders.

The defence set up a number of reasons and grounds why no infringement had been committed and why there was no patentable novelty in the assumed invention. These the judge considers in detail, with considerable prolixity and a generous use of the scissors, his decision running a length of nearly 100 typewriter pages. After showing how necessary it was to avoid "drop" in the consumption circuits, in order to make incandescent lighting feasible over large areas, he holds that up to 1880 nobody had reached the goal and that "only Mr. Edison seems to have found the solution and by this invention," under the limitations of the phraseology of the claims, and as admitted in the testimony of experts on both sides. The invention was not obvious and was something more than "good engineering." The following summary from the brief of the complainant, Judge Green cites as expressing fairly and justly what Mr. Edison accomplished :

"That it supplies electricity to consumers using large numbers of incandescent lamps under the Multiple Arc System, requiring the maintaining of relatively equal difference of potential at their terminals, and so located with reference to each other, and to the stations from which they are supplied, that if supplied at one end of the circuit the drop in tension between the nearest and most remote end could not be tolerated. That the supply is from a central station separated from and uncontrolled by the consumers, or they by it. That these large numbers of lamps are connected with one or more consumption circuits, the main conductors of which consist of direct and return wires so proportioned to the number and distance of such lamps that any fall in tension between the lamps nearest the feeder and those more remote is always negligible. That the lamps are of the kind described and referred to in previous patents and applications of Mr. Edison, as giving light by means of a continuous incandescent conductor. That the means of supply and regulation so as to compensate for the uncontrolable action of separate consumers shall be from the central station, and through the feeding conductors upon which all non-negligible drop in tension is localized, and which being free from connection with any lamps upon the consumption circuit are so situated with reference to the lamps, that any desired drop in tension required by necessary economy in the size of the conductors may be made upon them without harmfully affecting any lamps or disturbing the equality of the candle power throughout the whole system. That the exclusive control over the feeding conductors is insured to the central station by omission of all direct connections of the feeding and translating devices of any kind."

Judge Green brushes aside the alleged anticipations in the patents of Werderman, de Khotinsky and Lane Fox, as none of them going to the root of the matter or affecting the real issue. Werderman in 1878 had merely what is technically known as the "reversed parallel," and the idea of the division of a circuit into feeders, and consumption conductors did not appear to have ever entered his head, still less the proportioning of the copper in the system. The de Khotinsky invention of 1875 had only one diagram which appeared to touch in any degree the scheme of Edison, but there was nothing said about proportioning of the circuits or attempting to cure variation in candle power of lamps. In short, de Khotinsky gave no sign of attempting to deal with the difficulties of "drop in tension" in an extended system of lighting. Next came the two Lane-Fox patents of 1878, and a Lane-Fox letter in the *London Times*, of December, 1878, describing a system of incandescents in multiple, run from a central station. But that which Lane-Fox had in mind was evidently the "Tree system," in which to equalize things he proposed to enlarge the system of conductors as they approached nearer the central station. This he proposed to help out with storage batteries at various points. It was not at all the same thing as Mr. Edison's invention :—

"It must be borne in mind that Mr. Edison's invention was to localize the drop in tension which was inevitable, where it would be perfectly harmless, so far as the operation of the lamps upon the system was concerned. The effect which he produced by his invention was to strip the consumption circuit of all harmful drop in tension, so far as that circuit was concerned; the result is as if no such thing as drop in tension, perceptible in its effect, existed at all. Clearly the main and chief thing accomplished by Mr. Edison was this division of the circuit. Now in the Lane-Fox system of electric lighting the whole circuit is a consumption circuit from beginning to end. The diagram which he annexes to his patent, and which he refers to in his specifications clearly show that all of the circuit was to be used as affording stations for lamps. And this means of overcoming drop in tension, other than the enlargement of his conductors, was the use of supplementary batteries which were placed throughout the system. It would require the assistance of a vivid imagination to draw an analogy suggestive and educational in its character, between such a system, so planned and devised, and to be so operated and that of Mr. Edison. Save that in both systems conductors and electrical energy and incandescent lamps, and central stations are used, there is no patent similarity. The intent may have been identical; the means of realization are diverse. If it needs the close and acute examination of skilled experts to discover any similarity between inventions, such necessity would seem to deny the existence of suggestive character in either."

In this part much use is made of the testimony of Mr. F. L. Pope, Sir W. Thomson, Mr. Brevoort, Dr. Chandler, Mr. W. J. Jenks and others.

Judge Green next considered the alleged anticipations in the arts of electro-metallurgy, including the work done by Mr. Edward Weston at Newark prior to 1877. The Judge's mind found it "exceedingly difficult to draw any analogy between them and the lighting by electricity of large areas in which the necessary drop by tension is necessarily overcome;" and if there was such similarity, why did not somebody see it when the scientists were all groping around for a solution of the problem attacked in Mr. Edison's patent? "Certainly a non-expert, though never so alert would scarcely discover resemblance between two things so utterly dissimilar" as an electrolytic bath and an incandescent lamp. The Judge held that in such work in plating as that done by Mr. Weston, there was no chance for a harmful "drop" in potential between dynamo and bath. The rods were thicker than the wires leading to them, not to overcome drop of current but to prevent drop of the articles; and short, because of the limited dimensions of the bath.

The interesting use of kindred methods in gas and water was then considered by Judge Green, and numerous authorities reviewed.

"So far as the distribution of water was concerned, the defendants claim that the statement made by Mr. Church, as to the distribution of the water supply in New York, of Mr. Greenough as to the distribution of water in Boston, and of Mr. Brown, as to the distribution of water in Pittsburgh, fully sustain their contention.

"It must be admitted that for certainly 50 years back, and more perhaps, it has been the custom to have in the distribution of water and gas, to customers distant from the reservoir or holder, independent mains or lines of pipes from which originally no service pipes were laid, and which were used simply to carry the water or gas to a point generally in the centre of the general system for the purpose of overcoming the effect of friction by a new supply of the gas or water to be furnished. The theory of the defendants is this, and at first glance it is extremely plausible, that the analogy between the flow of the liquids gas and water, and the flow of the current of electricity is exceedingly strong and almost identical; and that any reputable engineer would necessarily, upon but little thought, adopt, from his knowledge of the distribution of gas and water, the same method and plan for dealing with the electric current. On the other hand the complainant insists that the problem to be solved is wholly different with regard to water and gas on the one hand, and electricity on the other. That in the one case, a retardation of the flow by the action of friction was the sole difficulty to be considered. In the other how to deal with the absolute loss of the current itself, became the vital question; its thorough destruction lay at the basis of the problem which so tried their ingenuity. And they asserted that differences, radical and unexplainable, existed between the ponderable bodies which are called gas and water, and that imponderable and intangible vibratory action of molecules which is called electricity. Many differences between them were cited upon the argument, the effect of which was, necessarily to weaken very much, if not entirely to destroy the theory that there was a distinct and positive similarity between gas, water, and electricity which would justify analogy in their treatment. It would be simply impossible to analyze and state, here, these different theories.

"Evidently the questions thus submitted to the adjudication of the Court are questions primarily for learned experts and they were so dealt with in this case. A battle royal has been fought between those who have presented the theories of the defendants, and those which have explained and illustrated the contentions of the complainants. Weighing the testimony as best I can, and after the most careful consideration, I am of the opinion that neither the distribution of water, nor of gas, nor the various publications referring thereto, and suggesting methods therefor, could have formed a basis upon which Mr. Edison could have successfully constructed his system. It would be tiresome in the extreme, if all the opinions advanced by the experts on either side touching this point were quoted. I shall simply say that the evidence given by Sir William Thomson, the leading British scientist, upon this part of the case, is so satisfactory, and as it seems to me so logical and convincing, that I give it unqualified assent."

Sir William Thomson's testimony is then quoted at great length, and Prof. George Forbes is also shown to have strongly denied the essential likeness of electricity with gas or water. Dr. Morton, too, and others who must have been aware of the methods used in gas and water distribution, did not hesitate to challenge as impossible the statement that Edison had done what he claimed. Yet had the analogy been so striking they would not, or should not, have doubted.

Judge Green then closes his decision as follows :—

While it is admitted by the experts on both sides in this case, that all the learned electricians of the world, in 1880, were individually engaged each in his own way, in attempting to solve the problem of the distribution of the electric current over large areas, so as to be successful, not one of them, so far as the testimony in this case goes, and so far as our knowledge extends, ever thought of adopting the means which it is alleged was used to equalize the pressure in water and gas distribution, or to equalize the pressure in electrotyping or electroplating, to overcome the harmful drop in tension, necessarily found in sending the electric current to a large number of incandescent lamps. Surely if these were anticipations, or if they were so educational in their character, and in their effect, as is claimed by the defendants to-day, we would have seen the practical result in the operations of the minds of scientific gentlemen scattered all over the world who were diligently seeking to solve a problem which notwithstanding all this previous knowledge seemed to them practically unsolvable.

There were other patents and publications mentioned and some criticism made upon the original proceedings in the Patent Office by the defendants, but I do not think it is necessary to consume time in discussing them. I have gone over what I have considered seems to be the strongest points of the defence, points which were relied upon at the argument, and my conclusion is, that they do not successfully disprove the claim which Mr. Edison has made to be the first inventor of the combination described in these letters patent. I think it is clearly proved that he was the first to conceive of such an arrangement and proportioning of the consumption and conducting wires of a circuit, that the inevitable result would be to secure uniformity of pressure throughout the whole system. He was the first to divide a circuit covering a large area into smaller consumption circuits, in which the drop in tension would be negligible without the expense of a very large sum of money in increasing the copper of his wires. He was the first to obtain the equalization of candle-power; he was the first to supply his consumption conductors with feeding conductors set apart for that purpose only. He was the first to localize upon feeding conductors the drop in tension, so that the loss upon the consumption conductors was always negligible.

It is difficult, impossible, perhaps, to describe what invention is. If invention implies something more than a mere change of form or arrangement or mode of use, if it be the result of inventive, as distinguished from mechanical skill, if it be the result of the operation of the intellect, not following the beaten track but striking out into some new direction, and achieving some new triumph, if it be the resultant of the exercise of the creative skill and genius in harmonious combination, then I think Mr. Edison, so far as the matters involved in this suit are concerned, should be termed an inventor of high order.

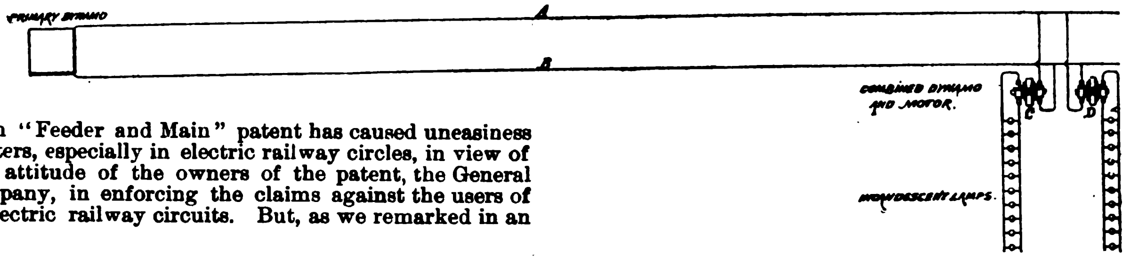
The defendants deny infringement. Considerable testimony was taken on both sides with reference to infringement, and as usual there is some contrarity of statement, but the weight of evidence shows clearly that the defendants had adopted the system of electrical distribution which Mr. Edison had described in these letters patent, and in so doing have clearly infringed the claims now in suit. It is not necessary to consume time in discussing the evidence on this point. Some technical questions touching the pleadings in the cause were presented at the opening of the argument. But as leave was given to make such amendments as might be necessary to present the real merits of the controversy they may be regarded as out of the case.

There must be a decree as prayed for in the bill."

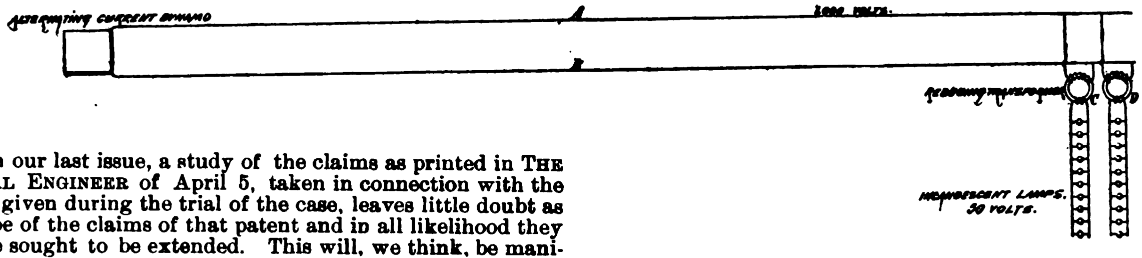
DR. CHANDLER'S TESTIMONY IN THE EDISON "FEEDER AND MAIN" PATENT SUIT.

THE decision of Judge Green, of United States Circuit Court for the Southern District of New Jersey, upholding the validity of the Edison "Feeder and Main" patent has caused uneasiness in some quarters, especially in electric railway circles, in view of the probable attitude of the owners of the patent, the General Electric Company, in enforcing the claims against the users of feeders on electric railway circuits. But, as we remarked in an editorial in our last issue, a study of the claims as printed in THE ELECTRICAL ENGINEER of April 5, taken in connection with the testimony given during the trial of the case, leaves little doubt as to the scope of the claims of that patent and in all likelihood they will not be sought to be extended. This will, we think, be manifest upon an examination of the testimony given by Prof. C. F. Chandler, who appeared on the stand as expert for the Edison Electric Light Company, the complainants in the suit in question, and from which we make the following abstracts:

Defendant's Exhibit. Chandler Diagram Nº 5



Defendant's Exhibit. Chandler Diagram Nº 4



299 *x-Q.*—Would such electric motors as are commonly used on central station multiple arc circuits, or such as are used for electric railways be, in your opinion, an equivalent for the incandescent lamps mentioned in these three claims, if they were used in a system of distribution which was in other respects such as that described in the patent in suit, but without any incandescent lamps in the consumption circuit?

A.—I should not think they would, as I think the claims are limited to incandescent lamps.

300 *x-Q.*—Why would not such motors be an equivalent for the incandescent lamps mentioned in the claims?

A.—Because the three claims distinctly say "lamps" and the specification at the outset describes the lamps.

301 *x-Q.*—It is, then, your opinion that, if a distribution system were constructed and organized in all other respects as described in the patent in suit and as shown in the drawings, except that electric motors of the character specified in cross-question 299 were used in the consumption circuit instead of incandescent electric lamps, the system so constructed and organized would not be covered by either of the first three claims of the patent in suit?

A.—That is my opinion.

310 *x-Q.*—Please examine the diagram now shown you and state whether or not the apparatus illustrated by it would be substantially the same as that referred to in either of the first three claims of the patent in suit, assuming that *C D* (Diag. 3) represent motor dynamos of the character specified in the last question; that each is used to operate a considerable number of incandescent lamps in its secondary circuit; that the distance and the number of lamps are such as to make the cost of sufficiently large supply conductors (represented by *A B* in the diagram) to bring the loss of pressure in them within the negligible limit, a matter of serious importance, and that the current is regulated at the central station, or primary dynamo, so as to keep the pressure at the motors substantially constant?

A.—As I understand the diagram, there is no division of the conductors in either of the local circuits from the motor dynamos into feeders and consumption mains. The circuits are all consumption circuits. As I understand the first three claims of the patent in suit, this diagram would not correctly represent the structure described in the first three claims of the patent in suit.

311 *x-Q.*—Is it your understanding, then, that the first three claims of the patent in suit are limited to a distribution system in which the feeders or supply conductors are connected directly to the consumption main?

A.—That is my understanding.

312 *x-Q.*—Would the system illustrated by the diagram now shown you be (Diag. 4), in your opinion, substantially the same as that referred to in either of the first three claims of the patent in suit, making the same assumptions as are specified in cross-question 310, except that, instead of motor dynamos, reducing converters or transformers are used, and the current generated by the primary dynamo is alternating instead of continuous?

A.—Inasmuch as this diagram exhibits an interruption in the circuit between the supply conductors and the consumption mains, and provides for developing the current for actuating the lamps at this point of interruption by means of converters or transformers, the diagram does not, in my opinion, represent the structure described in the first three claims in the patent in suit.

313 *x-Q.*—Are you aware that electric railway plants, constructed substantially as assumed in cross-question 301, are in very considerable commercial use at the present time, and also that alternating current electric light plants, constructed substantially as shown in Chandler diagram No. 4, are in extensive commercial use?

A.—I am aware that electric railways are in operation in which the current is supplied from a central station, in which the motors are arranged in multiple arc, but I am not aware of the details of construction, and consequently I am hardly prepared to say that the distribution systems are constructed and organized in all respects, except the translating devices, in the manner described in the patent in suit. In fact, it is my opinion, from what I know, that all the translating devices on the electric railways are provided with regulating devices which are operated at the translating devices by the consumer, that is, the motorman on the platform of the car. I am aware that alternating current systems similar in character to those shown in your diagram marked Chandler diagram No. 4, are in use.

It will be noted that Prof. Chandler considers not only electric railway but also alternate current circuits to be outside the claims of the "Feeder and Main" patent, and in fact broadly any circuit in which the lamps are not directly connected to the feeding circuit.

THE GOEBEL CASE REVIVED AS A DEFENCE IN ST. LOUIS.

EDISON ELECTRIC LIGHT CO. *vs.* COLUMBIA INCANDESCENT LAMP CO.

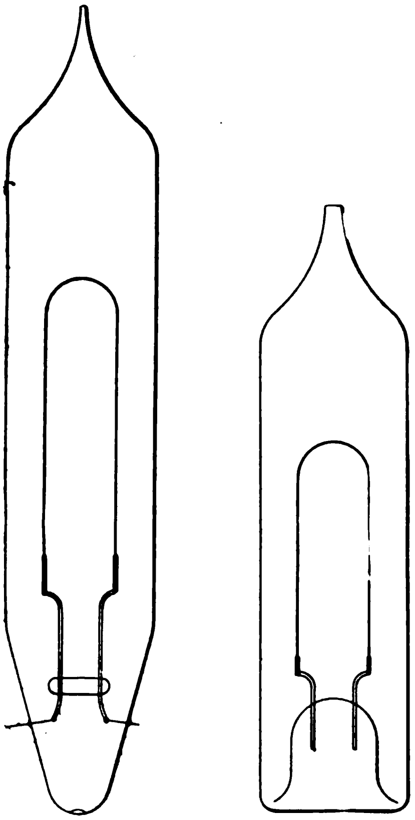
THE EDISON ELECTRIC LIGHT COMPANY having brought suit against the Columbia Incandescent Lamp Company, of St. Louis, for infringement of the Edison lamp patent, Mr. Rhotehamel of the Columbia Company made a gallant fight for life last week, using the Goebel case as a defence, and supplementing the previous record with a vast amount of new evidence. The case came before Judge Moses Hallett, in the U. S. Circuit Court for the Eastern District of Missouri last Tuesday and lasted until Friday.

Arguments for the complainant were made by Messrs. Seward, Fish and Dyer, and for the defendant by Messrs. Witter & Kenyon, —supported on both sides by local counsel. The complainant submitted 120 affidavits, and the defendant no fewer than 222. Among the exhibits were six lamps, three of the "meat saw" type and three "hair-pin". Of these lamps three were identified as having been made prior to 1879. We illustrate the new lamps Nos. 9 and 11 and give the important affidavits relating to them.

The arguments were finished on Friday when Judge Hallett took the case, and said he hoped to render a decision within a week.

AFFIDAVITS IN COLUMBIA CASE, ST. LOUIS.

Henry Goebel makes an affidavit in this case in the German language, of which the principal points are hereinafter given in translation. Has been shown two lamps marked respectively "J. C. Goebel, lamp No. 9, and Dr. Wm. J. Mayer, lamp No. 11;" recognizes lamp No. 9 as of his own manufacture; verily believes it to be an original lamp made long before 1879; recognizes the glass work, the carbon, the carbon work and every detail; made and used many lamps like this before 1879; would know it anywhere and at any time. The small shoulder was blown in the glass intentionally so that the lamp could be readily mounted in a plaster-of-paris socket; generally mounted these lamps in this way; generally used on his telescope wagon lamps like No. 9, and similar ones about his house; placed one over his daughter's sewing machine for her evening work; she was a dressmaker. Recognizes also the carbon and the carbon mounting of lamp No. 11, as his own; also the shape of the glass work and the sucking in of the glass at the lower end of the tube, as like that which he did in the early seventies and again in the early eighties; does not know whether or not he made this lamp as a whole; is quite sure that he made the carbon and the mounting; these lamps were not as good as the type represented by lamp No. 9 and he never made very many of them.



Goebel Lamps Nos. 9 and 11.

George K. Clark, lives in New Haven, is a machinist; has known John C. Goebel for 10 years; seven or eight years ago he told deponent that his (Goebel's) father had made incandescent lamps many years before; deponent expressed to him a desire to have one of these lamps; shortly afterwards Goebel gave deponent two long slim tubular lamps like the one marked "J. C. Goebel, Lamp No. 9;" never saw such a lamp at any other time in his life; within two or three months after, deponent mounted one of these lamps in a pine block with plaster-of-paris; the wires which went through the glass were very small and looked like platinum; connected this lamp in multiple on the arc light circuit; noticed it give a first-rate light when one of the carbons in the arc series drew a long arc, but very feeble when the carbons were all burning; had a variable resistance in the shunt circuit with the lamp, and a safety fuse to protect the lamp from excess of current; this lamp was set up and run in this manner at the Bigelow Company's works in New Haven, where deponent then was and still is working; it was run for six weeks or two months, most of time when the arc lights were burning, but more as a curiosity than anything else; the glass globe was finally broken, as deponent thinks, by the shrinking of the base; does not know what became of the lamp after that; nor what became of the other lamp; had it around the house for a long time, and then it disappeared; has searched for it but has not been able to find it.

William Bigelow lives in New Haven, is a machinist in employ of the Bigelow Company in that city; remembers that six or seven years ago, George K. Clark, an employé of the company, brought to the factory a small incandescent lamp in the form of a tube or cylinder; it was just like exhibit lamp No. 9 except that he thinks the glass tube was larger in diameter, helped Clark fix this lamp in a block of wood with copper wires attached, and hung it up in the tool-room of the factory in the arc circuit; has read Clark's affidavit and his statement is correct as to way lamp was mounted and run; tried it in the arc circuit to see what it would do; after running six weeks or two months it broke; remember this distinctly, because when it broke it made a loud report; remember that something struck it; Mr. Clark was not there at the time; remember picking up the pieces and putting them on a shelf in the tool room; the lamp varied in brilliancy from time to time according to the burning of the arc lamps, just as Clark has described it in his affidavit; this trial was made six or seven years ago; the arc lamps referred to were used in the factory to furnish light.

George W. Bigelow, lives in New Haven, is acting as engineer of the Bigelow Company in New Haven; has known John C. Goebel ever since he was employed at the wire-works in that city; about six years ago George K. Clark spoke to deponent about some incandescent electric lamps that he said had been made by Goebel's father; deponent's son William, and Clark soon after fixed up an incandescent lamp in the arc circuit at the works of the Bigelow Company; they experimented with it for some weeks; thinks it was lamp shown deponent marked "No. 9;" the enclosing glass was in the form of a cylinder and not pear-shaped; deponent got the impression, either from Clark or Goebel, that Goebel's father was among the earliest experimenters in this branch of electricity; deponent's brother, now deceased, was founder of the Bigelow Company, and was at one time Governor of Connecticut.

Albert H. Clark, deposes that he is a son of George K. Clark; remembers that his father had a lamp like No. 9 in his bureau drawer when he lived in Prospect street, which was more than six year ago; in the same drawer was kept an ordinary pear-shaped lamp; is familiar with electrical goods; the shape of the carbon filament in the lamp his father had was that of a hairpin, as in exhibit lamp No. 9, as near as deponent can remember of about the same thickness; does not know where the lamp is now.

The affidavit of **John C. Goebel** says that lamp marked "J. C. Goebel Lamp No. 9" was given him by his mother, with at least two others, before May 2, 1879, and has been in his possession ever since. The others are lost. No. 9 was always where he could put his hand upon it until a year and a half ago when his daughter took to her home the trunk in which they were kept. He had frequently showed them to friends and explained that his father had made them before Mr. Edison had invented his lamp. At one time—in 1881, he thought—he put one of these lamps on the first dynamo set up at the New Haven Wire Mills. The lamp gave a very bright light and did not break, but burned satisfactorily. No. 9 is now, he said, in precisely the same condition as when his mother gave it to him. Lamp No. 4, being shown him, he said he could not tell whether or not he had seen it before, as there was no way of distinguishing it from others in his father's possession. Did not realize the importance of looking up the lamp now known as No. 9, although he had been asked by Mr. Bull to do so, until he read in The Electrical Engineer that the Judge had criticised the case because only one "hairpin" lamp had been found. Remembers hearing his father say during 1881 or 1882 that a Mr. Bohm, who was working for the American Company, came to his shop only to steal information, and that his father cautioned the family not to let Mr. Bohm see anything. Indeed his father was of a very suspicious nature, often imagined that people familiar with the art to which his inventions related were trying to steal them, and to such persons he could not be persuaded to speak of his work.

In a supplementary affidavit, **John C. Goebel** said that on March 2, 1893, Mr. George K. Clark had reminded him that he had given to him (Clark) two tubular "hairpin" lamps. This fact Goebel had forgotten, but now distinctly remembers the circumstance. This is what became of the other two lamps given him by his mother in 1878. He is now positive that these lamps were given him within at least a week of June 3, 1878, when his naturalization papers were made out, in view of his intended visit to Germany which was afterward given up.

Dr. William Mayer, a dentist, of 1024 Chapel street, New Haven, Conn., said he had known Henry Goebel eight or nine years and had often visited him at his store on Grand street, New York City. About 1885, Goebel had given him one of his old incandescent lamps and had talked of his work. Deponent understood from his conversation that the lamp given him, and also many others, were made years before, and prior to the making of incandescent lamps by anyone else. This lamp is marked, No. 11. Goebel also gave him a pear-shaped lamp at the same time as the other. Before that time John C. Goebel had told him that his father had made incandescent lamps before Edison or anyone else had made them, and that he had used some of them on the wagon upon which his telescope was mounted, away back before the war.

Lamp No. 11 was in perfect condition when given by Goebel, and originally contained a vacuum. About a year later it broke, During his first visit to Goebel the latter had shown him a vacuum pump and said he had used it a long time. The pump looked old.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED MARCH 28, 1893.

Alarms and Signals:—

Circuit of Electric Signaling. M. Martin, Malden, Mass., 494,279. July 14, 1890.

A circuit by means of which messages may be transmitted over either a metallic or a ground circuit, or both, so as to insure the reception of the signal if the circuit has become deranged.

Electric Annunciating Push Button, J. King, Chicago, Ill., 494,337. Filed June 24, 1892.

A push button containing a buzzer for the purpose of notifying the operator that the signal system is in proper working order when the button is pushed.

Electric Signaling Apparatus, F. Pearce, New York, N. Y., 494,345. Filed Nov. 2, 1892.

A signaling system for use in communicating between cars and the power-house of a cable railway system.

Electric Signal, Switch Moving, and Inter-Locking Mechanism, J. Ramsey, Jr. and E. W. Harden, Cincinnati, Ohio, 494,489. Filed Aug. 18, 1892.

Block Signal System for Railways, E. Fontaine, Detroit, Mich., 494,525. Filed July 11, 1892.

Galvanic and Thermo-Electric Batteries:—

Pyro-Electric Battery, T. G. Hall, Chicago, Ill., 494,199. Filed Mar. 8, 1892.

Employs an element composed of a porous insulating cup containing a smaller similar cup; and material of opposite polarities contained in each of the cups.

Heating:—

Electric Heating Apparatus, M. W. Dewey, Syracuse, N. Y., 494,291. Filed Mar. 24, 1892.

Consists of a plate on two edges of which saddles of insulating material are placed and a resistance conductor wound around the plate alternately across opposite planes: the plate being enclosed in a perforated case.

Induction System of Electrical Heating, S. B. Jenkins, Boston, Mass., 494,295. Filed May 28, 1892.

The chief feature of the invention consists in means for utilizing the heat of hysteresis in a heating system for buildings.

Electrically Heated Radiator, W. Mitchell, Malden, Mass., 494,301. Filed June 8, 1892.

Lamps and Appurtenances:—

Process of Manufacturing Filaments for Incandescent Lamps, A. de Lodyguine, Paris, France, 494,149. Filed Sept. 14, 1888.

Process consists in dehydrating and decomposing the incandescents by the action of a chemical agent and then subjecting them to a high temperature with the exclusion of oxygen; after that expelling the occluded gases and coking the incandescents by the passage of an electric current, and finally giving them the required resistance by the deposition of carbon.

Process of Manufacturing Filaments for Incandescent Lamps, A. de Lodyguine, Paris, France, 494,150. Filed Sept. 14, 1888.

Process consists in heating a carbonized organic filament in a vacuum by an electric current until the filament is changed into a hard carbon and its permanent resistance is reduced to approximately a hot resistance of the carbonized heat.

Filament for Incandescent Lamps, A. de Lodyguine, Paris, France, 494,151. Filed Sept. 14, 1888.

A process similar to that described in patents, Nos. 494,149 and 494,150. (See THE ELECTRICAL ENGINEER, April 5, 1893.)

Electric Lamp Support, C. E. Richardson, Springfield, Vt., 494,348. Filed Nov. 16, 1892.

Globe Holder for Electric Arc Lamps, W. A. Turbayne, Detroit, Mich., 494,490. Filed July 1, 1892.

Electric Lamp Vibrator Regulator, D. M. Moore, New York, N. Y., 494,531. Filed Nov. 28, 1892.

A controlling socket, or "dimmer," for direct current incandescent lamps. (See THE ELECTRICAL ENGINEER, March 29, 1893.)

Metal Working:—

Treatment of Metal Plates Prior to Electrolysis, C. B, Schoenmehl, Waterbury, Conn., 494,231. Filed April 11, 1892.

Apparatus for Electrolyzing Copper, C. B. Schoenmehl, Waterbury, Conn., 494,232. Filed April 11, 1892.

Measurement:—

Electrical Meter, G. Rennerfelt, Buffalo, N. Y., 494,225. Filed April 1, 1892.

Consists in the combination with driving and driven cones and the movable core of an electromagnet, of a yoke connected with the core and movable along and between the cones lengthwise; a bar transversely movable in the slide ways of the yoke and a transmitting friction wheel mounted on the bar in the plane of the axes of the rolls.

Alternating Current Meter, W. Stanley, Jr., Pittsfield, Mass., 494,513. Filed Aug. 11, 1892.

An alternating current wattmeter for recording power from an alternating current at any pressure. (See THE ELECTRICAL ENGINEER, April 5, 1893.)

Miscellaneous:—

Magnetic Lock, A. E. Kintner, Painesville, O., 494,146. Filed Apr. 4, 1892.

Electrical Excitation of Vacuum Tubes, H. T. Barnett, London, England, 494,239. Filed Feb. 5, 1892.

An arrangement by which a plurality of vacuum tubes connected in multiple can be evenly illuminated although their several resistances are different. (See THE ELECTRICAL ENGINEER, April 5.)

Stop Motion for Knitting Machines, G. J. Manderfield, Royersford, Pa., 494,258. Filed Jan. 10, 1893.

Apparatus for Protecting Buildings from Lightning, J. B. L. Bartlett, Boston, Mass., 494,286. Filed Oct. 31, 1892.

Consists of wires of an electric circuit strung externally upon a building and an alarm arranged to be included in the circuit by the operation of the switch.

Electric Brush, R. E. Williams, Hot Springs, Ark., 494,359. Filed Nov. 29, 1892.

An electric brush having flexible rollers comprising the electrodes.

Lock, F. Simons, St. Louis, Mo., 496,446. Filed Oct. 22, 1892.

A door lock for use in connection with a burglar alarm system.

Electrical Switch Lock, F. C. Weir and E. W. Harden, Cincinnati, Ohio., 494,451. Filed Dec. 20, 1892.

A lock for use on interlocking systems of block signals for steam railways.

Electric Bolt Operating Mechanism for Safes, E. Stockwell and H. C. Stockwell, Stamford, Conn., 494,495. Filed July 11, 1892.

Electrical Instrument for Medical Purposes, B. Y. Boyd, Wichita, Kan., 494,520. Filed Dec. 15, 1892.

Railways and Appliances:—

Electric Car Fender, E. Rochester, Ottawa, Can., 494,281. Filed Oct. 18, 1892.

Controlling Device for Electric Cars, J. H. Neal, Boston, Mass., 494,344. Filed Dec. 30, 1891.

Provides means whereby both the brake and the current-regulating mechanism may be composed in a single shaft, and also means whereby the current may be reversed when necessary to change the direction of movement of the car.

Electric Railway, J. C. Henry, New York, N. Y., 494,477. Filed Aug. 19, 1890.

Comprises a stationary source of electricity, line conductors extending along the railway, a motor carried by the car having an armature and a branch circuit making a permanent connection with the line conductors, and a local circuit on the car including the field magnets and batteries whereby the latter are separably excited.

Driving Gear for Motors, J. C. Henry, New York, N. Y., 494,478. Filed Dec. 10, 1891.

Claim 1 follows:

The combination of a motor, axles having cranks connected by a stiff rod, a gear wheel rigidly fixed to said rod, and a pinion on the motor shaft meshing with said gear.

Electric Car Truck, J. C. Henry, New York, N. Y., 494,479. Filed Jan. 2, 1892.

Consists in the combination of a truck, a motor mounted thereupon and a differential speed-reducing gear one member of which rotates on a projection of the truck.

Car Brake, M. E. Company, Hamilton, Mich., 494,505. Filed April 5, 1892.

An electric brake by means of which the car is stopped by its own momentum by the use of a friction pulley.

Switches and Cut-Outs:—

Lightning Arrester, A. J. Wurts, Pittsburgh, Pa., 494,186. Filed Jan. 14, 1892.

Employs a single series of contact plates, a condenser for each plate of the series each of which has one side connected to its proper contact plate and the other side grounded; two arms adapted to come in contact with the series of contact plates in order, one being grounded and the other connected to the conductor to be discharged.

Telegraph:—

Printing Telegraph, J. E. Wright, New York, N. Y., 494,185. Filed Nov. 16, 1892.

A column-printing telegraphic instrument in which the carriage bearing the type-wheel is movable transversely and is governed by an escapement and a connection between it and the type-wheel capable of universal movement with respect to both.

Telephones and Apparatus:—

Telephone and Signaling Circuit, F. A. Pickernell, Newark, N. J., and F. W. Dunbar, New York, N. Y., 494,385. Filed Dec. 15, 1892.

A system in which the repeating coil is introduced when required by a positive operation but is automatically withdrawn by the act of disconnecting the office trunk.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED APRIL 4, 1893.

Alarms and Signals:—

Electrical Annunciator, J. B. Rogers, Washington, D. C., 494,762. Filed May 31, 1892.

For use in hotels, signal stations, etc.

Automatic Cut-Out for Electric Signaling Boxes, J. F. Mehren, Chicago, Ill., 494,786. Filed Jan. 8, 1892.

Principally for use with fire-alarm and police-alarm boxes.

Automatic Cut-Out for Electric Signaling Mechanisms, J. F. Mehren, Chicago, Ill., 494,787. Filed Jan. 8, 1892.

Similar in purpose to 494,786.

Jail Door Alarm, W. S. Hull, Sheffield, Ala., 494,923. Filed Sept. 19, 1892.

Circuit Closing Clock, H. S. Page, Medford, Mass., 494,966, Filed Oct. 3, 1892.

For sounding an alarm, closing gates, or other kindred purposes.

Batteries, Primary:—

Voltaic Cell, E. Weston, Newark, N. J., 494,827. Filed Nov. 24, 1891.

A cell of which the E. M. F. is practically independent of changes in temperature. (See THE ELECTRICAL ENGINEER, April 12, p. 355)

Separator for Battery Elements, C. P. Elieson, New York, N. Y., 494,849. Filed July 9, 1892.

A separator to hold the outer and inner electrodes apart and to maintain them at a uniform and constant distance from each other.

Galvanic Battery, D. H. Fitch, Cazenovia, N. Y., 494,852. Filed Nov. 22, 1892.

Relates to the form and construction of parts.

Clocks:—

Electric Clock, H.. Wubbeler, Beaver Falls, Pa., 494,832. Filed May 21, 1892.

Dynamos and Motors:—

Controlling Switch for Electric Motors, W. S. Hill, Boston, Mass., 494,565. Filed March 31, 1892.

A rheostatic switch for use in starting and stopping electric motors.

Means for Switching Generators or Motors in or out of Circuit, N. Van Denburgh & F. H. Loveridge, Chicago, Ill., 494,608. Filed Feb. 23, 1892.

Acts without breaking the contiguity of circuit. Consists in first cutting the field-magnet out of the main circuit and into a local circuit, and then cutting the armature out of the main circuit and into a local circuit.

Commutator Brush for Dynamos, D. W. Dunn, Pittsburg, Pa., 494,629. Filed Aug. 13, 1892.

A commutator brush of pulverized carbon and silicate of soda with sheets of copper gauze interspersed therein.

Brush Supporter for Dynamo Electric Machines, A. Ekström, Lynn, Mass., 494,789. Filed Nov. 16, 1892.

Brush supporter consists of a split ring surrounding the commutator.

Circuit Controller for Electric Motors, W. S. Hill, Hyde Park, Mass., 494,781. Filed May 16, 1892.

For controlling the operation of an electric motor to start and stop it automatically under predetermined conditions. Shown as specially applicable to elevator water-tanks.

Dynamo Electric Machine, A. S. Baxendale, Selangor, England, 494,836. Filed April 22, 1892.

A machine of the type employing an oscillating armature in contradistinction to a revolving one.

Electric Generator or Motor, W. T. Goolden & L. B. Atkinson, London, England, 494,856. Filed Jan. 3, 1893.

Adapted for use in mines Consists mainly in means of protection against inflammable atmospheres, dust and dampness.

Electric Motor, F. B. Crocker & S. S. Wheeler, New York, N. Y., 494, 978. Filed June 20, 1892.

Adapted to electric fans. Claim 2 follows :—

An electric motor sustained on an inclined base pivotally supported and having a fan attached to its armature shaft whereby the motor and its attached parts rotate around the pivotal support when the fan is set in motion.

Heating :—

Means for Electrically Heating Crucibles, W. Mitchell, Malden, Mass., 494,585. Filed June 13, 1892.

Crucible consists of two insulated parts, combined with a holder and circuit wires having terminals in contact with the two parts of the crucible respectively.

Apparatus for Electrically Heating Crucibles, W. Mitchell, Malden, Mass., 494,586. Filed July 28, 1892.

Consists in an enclosing shell or hollow forge composed of two sections of conducting material of high resistance and interposed insulating material. Between the shell and the crucible the intervening space is filled with a conducting material of high resistance for the evolution of heat.

Measurement :—

Electric Meter, M. E. Thompson, Boston, Mass., 494,657. Filed May 19, 1891.

Belongs to the class of motor-meters, and is adapted for the measurement of alternating currents.

Electrical Measuring Instrument, E. Weston, Newark, N. J., 494,828. Filed Jan. 14, 1892.

Adapted for the measurement of current strength or pressure. Operates through the expansion or contraction of an electrical conductor.

Recording Voltmeter, E. Weston, Newark. N. J., 494,829. Filed March 18, 1892.

Produces a continuous record of the variations in electrical pressure occurring in a circuit. Claim 1 follows: Two oppositely wound coils in electrical circuit supported on a common pivot shaft and vibrating in a field of force, an arm actuated by said shaft, a tracing device controlled by said arm, a moving record surface upon which said tracing device marks, and means for directing a current into one or the other of said coils as the electrical pressure rises above or falls below a given point in a circuit including said means.

Electrical Measuring Instrument, A. Koepoel, Berlin, Germany, 494,961. Filed Nov. 17, 1892.

An electro-magnetic apparatus. A needle of soft iron is located directly between the poles of a polarizing magnet. Intended to obviate the disadvantage of frequent demagnetization of the magnetic needles usually employed.

Galvanometer, E. F. Northrup, Ardmore, Pa., 494,964. Filed Nov. 5, 1892.

Discards the customary employment of an adjustable exterior magnet for varying the sensibility of the moving system in a sensitive reflecting galvanometer, and substitutes means of adjusting the magnetic field of the moving magnet system.

Miscellaneous :—

Electric Coal Mining Machinery, E. C. Morgan, Chicago, Ill., 494,587. Filed July 6, 1891.

Employs an electric motor to draw the cutting tool backwards, and a spring between the tool and the frame for thrusting the former forward.

Ground-Detector for Electric Circuits, E. Weston, Newark, N. J., 494,880. Filed Sept. 10, 1892.

Adapted not only to detect grounds in electric circuits, but to measure the insulating resistance of a circuit and show its conditions from hour to hour.

Railways and Appliances :—

Electric Locomotive Regulation, R. M. Hunter, Philadelphia, Pa., 494,705. Filed July 12, 1892.

Regulates by independently varying the counter-electromotive force of the motor or motors on each car.

Electric Railway Trolley, E. Martyn, Detroit, Mich., 494,721. Filed Sept. 19, 1892.

Aims to reduce the friction of running to a minimum. Employs ball or roller bearings.

Switches and Cut-Outs :—

Electric Switch, G. W. Webb, Wilkes-Barre, Pa., 494,610. Filed April 20, 1892.

For use with conductors carrying currents of high potential. Designed to avoid any interruption of continuity, and thus preclude arcing or destructive sparking.

Switch for Electrical Currents, H. P. Ball, Schenectady, N. Y., 494,750. Filed July 1, 1892.

A quick-acting or "snap" switch adapted for currents of high potential.

Means for Closing an Electric Circuit, H. L. Tyler, Corning, N. Y., 494,765. Filed Aug. 20, 1892.

Employs a diaphragm sensitive to the influence of light for actuating a circuit closing device.

Cut-Out for Brush Lamps, B. Adair & C. H. Klewer, Denver, Col., 494,995. Filed Nov. 18, 1892.

Designed especially for use in the Brush arc lamp.

Trolley Pole Catcher, E. L. Langheinz, Brooklyn, N. Y., 494,871. Filed Nov. 10, 1892.

Telegraphs :—

Telautograph, Elisha Gray, Highland Park, Ill., 494,562. Filed July 16, 1887.

A fac-simile telegraph. Employs two electric circuits from the transmitting to the receiving station, and two mechanisms, each actuated by one of the circuits, and responding respectively to movements of the transmitting pen in two directions crosswise to each other; the pen driving mechanism at the receiving station are caused to operate by the electrical effects respectively transmitted over the two circuits. The mechanism between the electrical devices and the recording pen at the receiving station is analogous to that of the pantograph. (See THE ELECTRICAL ENGINEER, March 22, 1893.)

MR. JOHN A. BARRETT, the electrical engineer, is devoting much of his time now to electric motor work, and has just been elected president of the Elektron Manufacturing Company of Springfield, which is now very busily engaged bringing out his electric elevator. The Elektron Company has made a specialty of elevator work for some time, and has already a large number of orders for the Barrett apparatus.

PERSONAL.

MR. J. W. GODFREY.

Compliments of J W Godfrey

WE present herewith a very faithful portrait of Mr. J. W. Godfrey, the energetic general manager of the New York Insulated Wire Company. To him, associated with Mr. R. E. Gallaher, the treasurer of the Company, the success of the institution is largely due. Mr. Godfrey is a New Yorker, having been born in this city or Sept. 15, 1855. After graduating from college he began his business career, and became actively interested in the manufacture and sale of small arms. His real opportunity came, however, in the electric wire industry, and no brand of insulation has ever been more enthusiastically advocated and pushed than has "Grimshaw" white core, and other specialties, by him. He has made white core literally a household word, by his propagandism in all parts of the country. Last year, he added to the triumphs of his company by securing the huge order for the electrical wire and wiring at the World's Fair, since which time he has been almost incessantly in Chicago with the object of having the contract carried out in the best manner known to the art. Mr. Godfrey is a man of strong public spirit, and has willingly devoted money and leisure to the promotion of every undertaking and body intended to advance the interests of electricity.

THE KENNELLY STANDARD AMMETER AND MILLIAMMETER.

ON another page of this issue we illustrate the new Kennelly standard ammeter and milliameter. These instruments are designed with a view to obtaining the highest accuracy with permanency of indication. To that end they are constructed without iron, steel or magnetic metal in their moving parts, and consequently will not alter or demagnetize under any reasonable treatment. The scales are nearly uniform and very distinct, being read off with mirrors to prevent parallax.

These instruments are at present built in capacities ranging up to 15 amperes which will shortly be extended to 50 amperes.

They have very low resistance and inductance, so that they possess great electromagnetic power, combined with very little influence upon the circuit whose current strength they measure. The resistance of the 500-milliampere instrument is 0.8 ohm, and its inductance 5 microhenrys. They are very compact and portable, the outside dimensions of the instruments being 6¼ inches x 8¼ x 2¼ inches high; and their weight in wooden case six pounds. These instruments are handsomely finished and the workmanship is of the highest grade. They are manufactured by the Edison Manufacturing Co., of 110 East Twenty-third street, New York city.

REDUCING FRICTION BY MEANS OF PURE FLAKE GRAPHITE.

FOR several months past an advertisement has appeared in the leading mechanical and technical papers offering to send free of charge a pamphlet describing the nature and peculiarities of graphite, with scientific opinions as to its value as a lubricant, and experiences of practical engineers and machinists.

The result is, there are hundreds, if not thousands, of wide-awake and progressive people who have a far better idea to-day as to the value of pure flake graphite for reducing friction in working parts of engines and machinery, and for lessening wear and tear and breakage in joints, gaskets, bolts, etc.

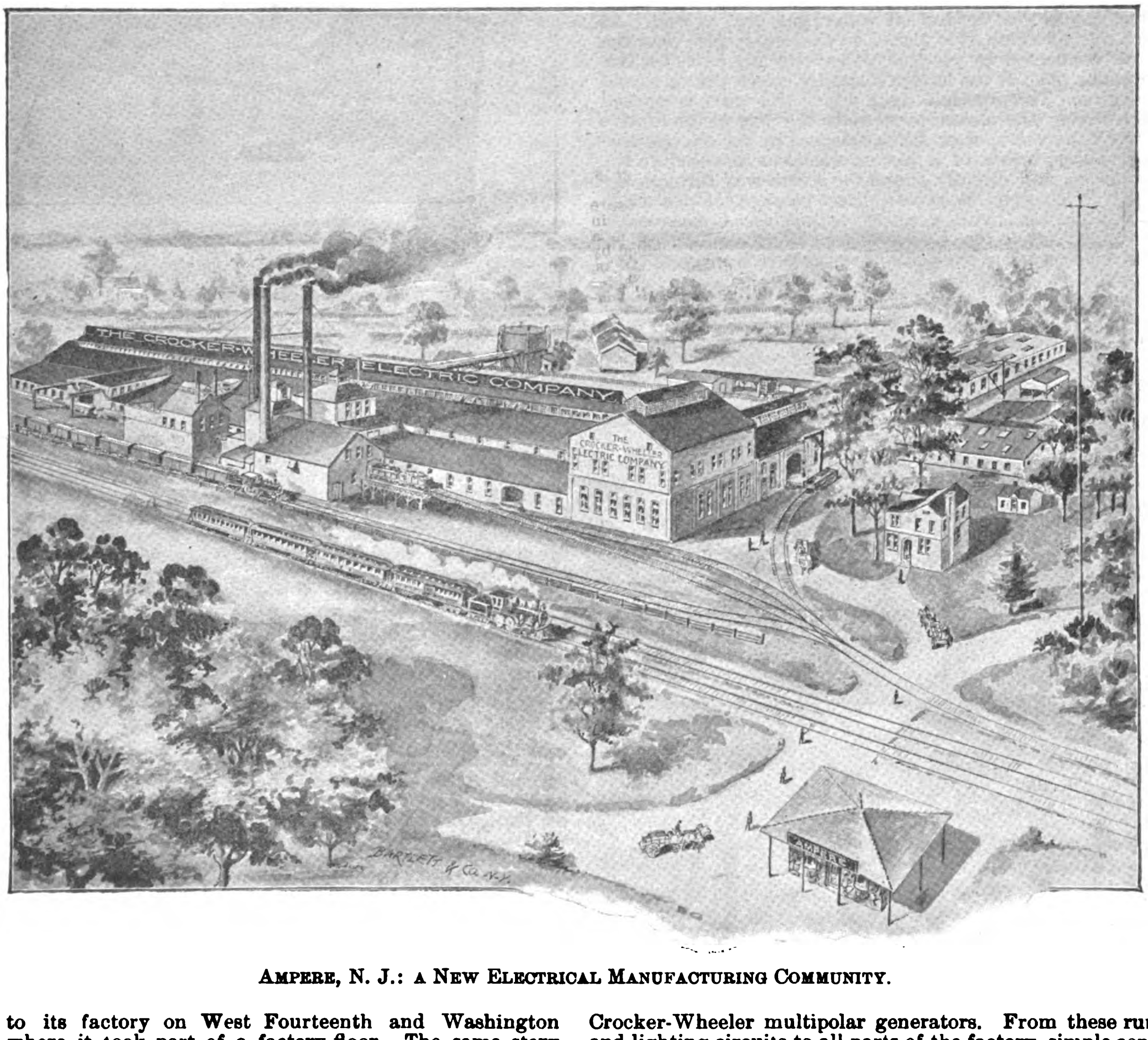
Graphite is commonly known as black-lead, but there is a wide difference in the material, as well as in its preparation for lubricating purposes, and a great deal of the stuff offered is worse than useless. It is for this reason that every one who has any use for a lubricant, and especially one that is possessed of such peculiar properties, should avail himself of an opportunity to see a sample and learn of its many uses. Such an opportunity is presented by the Joseph Dixon Crucible Company, Jersey City, N. J., who now not only offer to send their valuable pamphlet, but will also send sample of Dixon's pure Ticonderoga flake graphite free of charge.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

AMPERE, N. J.: A NEW ELECTRICAL MANUFACTURING COMMUNITY.

THE growth of the Crocker-Wheeler Electric Company has of late been so rapid that the Company has been compelled to take measures which will enable it to do justice to its immediate business and to its plans for the future. A few years ago, this young concern, organized by Dr. S. S. Wheeler and Prof. F. B. Crocker, started out very humbly in a small room over the District Post Office, on West Twenty-eighth street and Seventh avenue. Enlarged space was soon necessary, and the Company then removed to its factory on West Fourteenth and Washington streets, where it took part of a factory floor. The same story of rapid expansion was repeated, and the Company spread out so all over the building that it afforded a very good illustration of the story of the camel that wished modestly to introduce only his head into the tent. Moreover, the Company in preparing to build all practical sizes of apparatus found it difficult to handle such work in an ordinary building, well as it might answer for the purpose of turning out large quantities of the smaller machines on which the Company first made its reputation.


THE CROCKER-WHEELER ELECTRIC COMPANY
THE CROCKER-WHEELER ELECTRIC COMPANY
AMPERE
BARTLETT & Co. N.Y.

AMPERE, N. J.: A NEW ELECTRICAL MANUFACTURING COMMUNITY.

For these reasons the company had to cast about for better quarters, and these it has found in a pleasant suburb of Newark, N. J., whither it has now removed. It has named the place Ampere, and with its four or five hundred workmen has so thoroughly entered upon possession of the town that the community is strictly and exclusively an electrical one. The situation is so favorable as regards New York, the new factory is so well laid out, the facilities for handling raw material or shipping product are so good, and the machines of the company are in such high favor, that there is every reason to expect that Ampere will soon become one of the best known manufacturing centres in the country, bearing a name that is associated in the public mind with a celebrated product.

Ampere is located in the township of East Orange, N. J., on the Montclair branch of the Delaware, Lakawanna and Western Railroad, and only about eleven miles from New York; frequent trains from the foot of both Barclay and Christopher streets making it easy of access. The property includes seven acres of ground, with about 100,000 square feet of factory floor space. Extensive switches on the premises, and being in the immediate vicinity of both the Pennsylvania and Erie Railroads, and on the direct line of the D., L. & W. R. R., only two miles from the centre of Newark, make the shipping facilities unequaled.

A notable feature of the factory is the use it will make of electric power. The main machine shop, 400 feet long, paralleling the railroad and the electrical shop, 250 feet long, running back at right angles, will both be operated by electricity. Adjoining the machine shop is a large power-room with Buckeye engine and Crocker-Wheeler multipolar generators. From these run power and lighting circuits to all parts of the factory, simple copper rods taking the place of long and heavy lines of jack shafting or countershafting. A few tools built to be run by belt have been located in an extension or "L" of the machine shop, but everywhere else the copper bars may be seen and such tools as those described by Dr. Wheeler in his article, which appeared in THE ELECTRICAL ENGINEER last week.

In addition to the fine machine shop and electrical shop, there is a roomy testing department and laboratory under the charge of Mr. Gano S. Dunn, the electrical engineer of the company. There are also a large storeroom, stockroom, shipping department, etc. At the entrance to the property is a two-story office building to which run a Western Union telegraph line and Long Distance telephone line from the New York offices, with an operator on duty all day. Back of the main shops are a number of smaller buildings, used for draughting, patterns, etc. There is also a large stable, behind the office, where the horses and trucks belonging to the company are quartered available for general purposes, and in among a grove of lofty trees is a beautiful lake where electric launches can be tested. As the picture shows, there is a pretty little railway depot at the spot, and all around are the clustering homes of the workpeople, who are delighted to find that instead of paying rent for small flats in New York they can discuss local politics from the proud position of house owners and landed proprietors. To say that real estate at Ampere is "active" is putting it mildly.

The New York offices of the company have been opened in the Taylor Building, Cortlandt street, where Mr. Harvey L. Lufkin has charge of affairs, and is in constant communication with the works. The executive departments of the company have their headquarters in New York, and all the business of the company will be transacted from Cortlandt street.

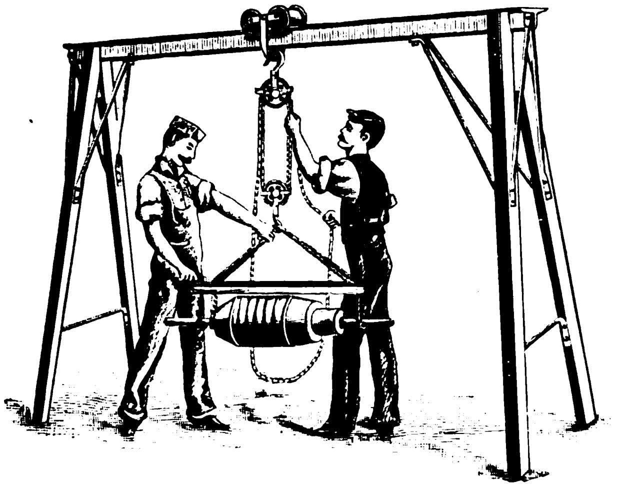
THE STANNARD ELECTRIC VALVE.

A NEW valve worked by electricity from any point desired has been invented by Mr. J. E. Stannard, 32 Ladd street, Springfield, Mass. This valve is designed especially for application to steam engines, but can be used to shut off water, gas, etc., as well. As applied to a steam engine, it is placed on the supply pipe near the throttle and connected by electric wires with any part of a factory, so that one push of the button instantly closes the valve and stops the engine. The principle upon which this valve is worked is that of utilizing the steam pressure in the pipe as the motive power to work the valve, after being released by the electric current. The valve consists of a piston, enclosed in a shell in the form of a cross, and directly across the steam way through the supply pipe. When open, it gives a direct passage for steam and stands in equilibrium, with steam on both sides. Consequently it does not move, but on the electric current being applied, a small exhaust valve is opened at one end, throwing the valve out of equilibrium, moving the piston and the shut-off valve across to its seat directly athwart the steam way, and closing it, thus stopping the supply of steam. This valve has been tested and it is said, has never failed to do its work. There being *no* wheels, clutches, belting or complicated parts to get out of order, it can be relied upon to act in case of emergency, as, for example when an immediate stoppage is necessary to save life or property.

Patents are now pending and any party interested can obtain further information from Mr. Stannard.

A USEFUL DEVICE FOR HANDLING ARMATURES, FIELDS, ETC., IN CENTRAL STATIONS.

THE BROWN ELECTRIC COMPANY, of Boston, Mass., have just put on the market one of the most serviceable adjuncts of the electric light station and power house, and one which will undoubtedly have a large sale. It is a portable crane with roller attachments, with which armatures and fields can be easily and safely handled. This crane is 12 feet long and 8 feet high, strongly built, and will last a life-time with proper care. Superintendents should investigate this labor-saving device.



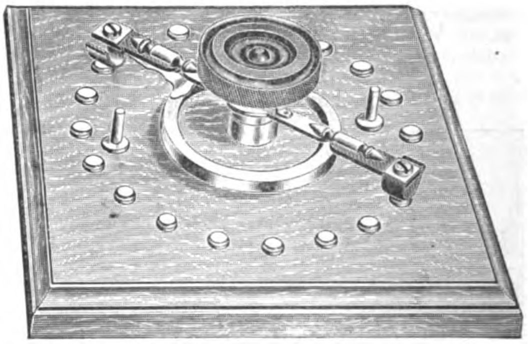
DEVICE FOR HANDLING ARMATURES, FIELDS, ETC., IN CENTRAL STATIONS.

THE CALDWELL BOILER CO., 15 Cortlandt street, New York, has been awarded an order for two boilers, 455 h. p., by the Western Union Telegraph Co., for their building corner of Broadway and Dey street.

THE E. E. & S. VOLTMETER SWITCH.

NEARLY all large buildings of modern erection maintain their own plants, often very extensive and complete, and usually including a switchboard of slate or marble holding the apparatus for the control of the plant. The grouping of a number of machines in this way, feeding into common bus bars, renders necessary means of controlling each one at any time and of uniting its action, especially with reference to voltage. For the latter purpose the Electric Engineering & Supply Company of Syracuse, N. Y., have recently placed upon the market in connection with their switchboards and voltmeter the voltmeter switch illustrated.

As the name indicates the instrument is to be used in connection with a number of generators in place of the primitive strap switch or the cumbersome plug method, adopted when the number of circuits becomes too large for the former. They are made in two styles, single and double pole. The arm is of brass, of two pieces, insulated and mounted on the central support. A light spring contact piece is carried on the lower side at each end, and as the arm is rotated by the corrugated hard rubber disc at the centre, these touch diametrically opposite posts. One contact spring is lengthened to bear on the ring on the base, and between this ring and the other arm through the centre post the voltmeter is connected. The test wires from the circuit are brought to opposite posts, and by turning the arm the voltmeter may be connected to any circuit or cut-out. Stops are provided to prevent reversal of the current. The switches for any number of circuits are shipped on wood bases for templates, or are put upon slate or marble bases.



THE E. E. & S. VOLTMETER SWITCH.

While there is nothing especially new in this instrument it fills a long felt want, and its convenience, neat appearance and workmanship commend it to all station men and electrical users who look after the details of their plants. This is shown by the fact that contractors specify it on boards of their construction.

LUXURIOUS TRAVELING.

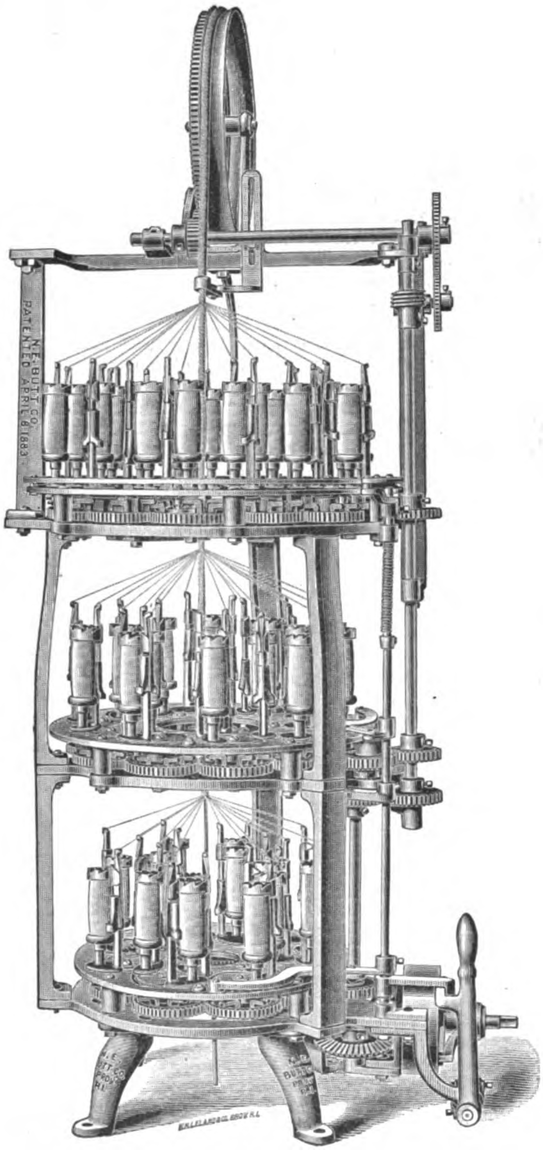
THE climax of comfortable and luxurious travel is apparently reached by the Chicago, Milwaukee and St. Paul Railway. Ease and comfort go with the traveler making a trip to Minneapolis, St. Paul, Omaha or Sioux City over this road. Their superb electric-lighted vestibuled limited leaving for these points early every evening is a great favorite, nothing being left undone by the officials or employees to ensure a most enjoyable trip. Excellent dining service is maintained and library cars are attached to the train, where current periodicals may be perused while smoking a cigar with all the pleasure of one's own "den" at home. Electric lights placed in every berth enable the traveler to spend his wakeful hours, after retiring, over his favorite novel or other reading matter. In fact, everything that goes to ensure a sense of comfort and security is provided. The trip requires but a night's run, bringing one at the destination ready for breakfast and business in the morning. Mr. Geo. H. Heaford, general passenger and transportation agent, and his co-laborers, have done all in their power to bring about these notable improvements.

ONE OF THE STUARTS.

MAYOR STUART, of Philadelphia, in his second annual message to City Councils says: "The city for years has been continually contending for the removal of all poles and overhead wires, yet by ordinances passed by you, notwithstanding the Mayor's veto, which permit this system of overhead trolley, there will be thousands of poles erected and several hundred miles of wires strung throughout the city. No other great city of our size has permitted overhead trolley as the general system for her street-car propulsion. I am yet firm in my belief that the future will show that by granting these privileges now a most serious mistake has been made."

A TRIPLE BRAIDER FOR TELEPHONE AND OTHER WIRES.

We illustrate on this page the new large gear triple-braider made by the New England Butt Company, of Providence, for telephone and other electric wires. It is made for 16, 20 and 24 strand and it has a 14-inch wheel take-up. It is also made in other sizes. These machines are also made with iron scored rolls if so desired.



Triple Braider for Telephone and Other Wires.

PHILADELPHIA NOTES.

Queen & Co., Incorporated, are making a special drive of their "Magnetic Vane" Ammeters and Voltmeters, which instruments are favorably known througout the country. They are adapted for constant switchboard use, and will render service 24 hours per day without disadvantage. This is an important feature and will be appreciated by those familiar with the subject. A number of the larger manufacturing concerns use these meters for installation work as they present great advantages in being constant, accurate, durable, handsome in appearance and low in price. More than twice as many were sold in 1892 as during the previous year. Circular No. 420, which contains full information, will be mailed by the makers upon application.

The Riehle Bros. Testing Machine Company, of Philadelphia, have recently sold to the American Telephone and Telegraph Company, of New York, a 30,000-pound vertical screw-power testing machine.

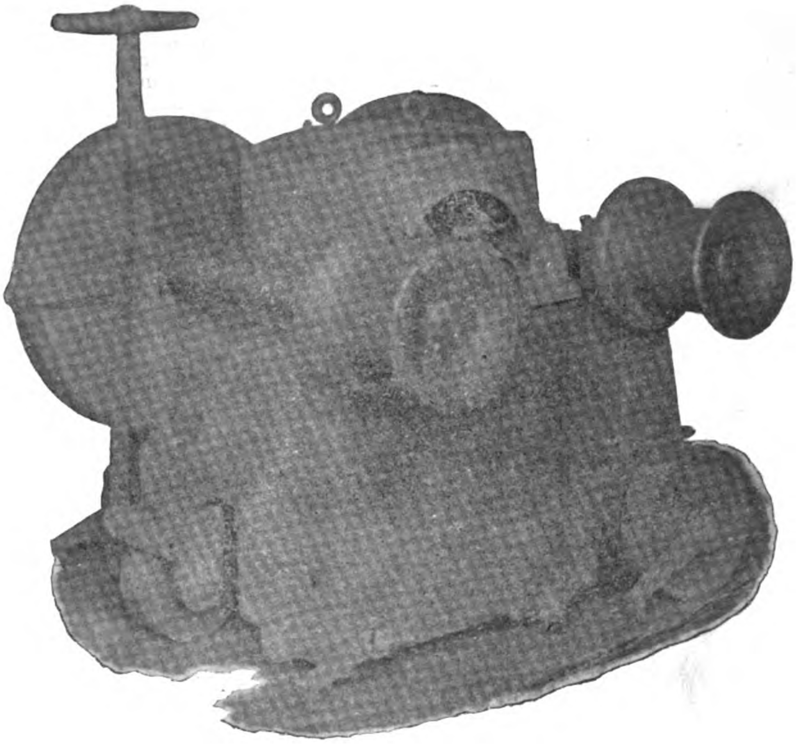
Prof. E. J. Houston.—At the last meeting of the New York Electrical Society, Prof. E. J. Houston of Philadelphia was elected an honorary member.

THE GENERAL ELECTRIC CO.'S 4-WINCH HOIST.

The four-winch hoist for use on wharfs and on vessels, is the latest device of this character which the General Electric Company has perfected. For use on shipboard, the winch-head hoist is more convenient than the drum hoist, as it is better adapted to the variety of hauling and hoisting incident to the manipulation of a ship's cargo. A number of loads may be raised or lowered simultaneously, each winch-head being independent of the others.

The apparatus illustrated consists of a base frame, a motor, two shafts, each carrying two winch-heads, and the necessary controling apparatus. The frame is a strong cast-iron box open at the top and bottom, and supporting on its upper rim the motor and winch-shaft bearings, each furnished with self-oiling mechanism. The frame is provided with wheels for convenience of application. The motor is of the latest design and is entirely enclosed by its own frame with the exception of two small lateral openings which allow of ready access to the brushes and armature bearings and which are closed when the hoist is in operation. It is so set in the hoist frame as to secure a low centre of gravity and great rigidity. The field coil of the motor and winding of the iron-clad armature are covered with special waterproof composition.

The winch shafts are of large diameter steel rods, to obviate the possibility of bending under heavy loads. The winch heads are keyed to the shafts over bronze bushings, and the difficulties which rust might create, forestalled. Each winch is provided with two safety pawls, which, when the hoist is in operation, are held out of action by centrifugal force, but which immediately catch into notches provided in the bearing cap, if the current fail while a load is being hoisted. This prevents overhauling of the hoist by the load, which might otherwise happen with disastrous results. The apparatus for controlling the hoist is placed below the motor within the frame, where it is protected from mechanical injury and moisture.



General Electric Co.'s 4-Winch Hoist.

The hoist has a capacity of 45 h. p. at the winches and is built for 110, 220 or 500 volt circuits. It has a lifting capacity (2 weights) of 8,000 pounds at a speed of 250 feet per minute; its total weight is 8,000 pounds. Its dimensions are as follows: length, 6 feet, 10 inches; width, 6 feet, 7 inches; height with wheels, 4 feet, 7½ inches; height without wheels, 4 feet, 5½ inches.

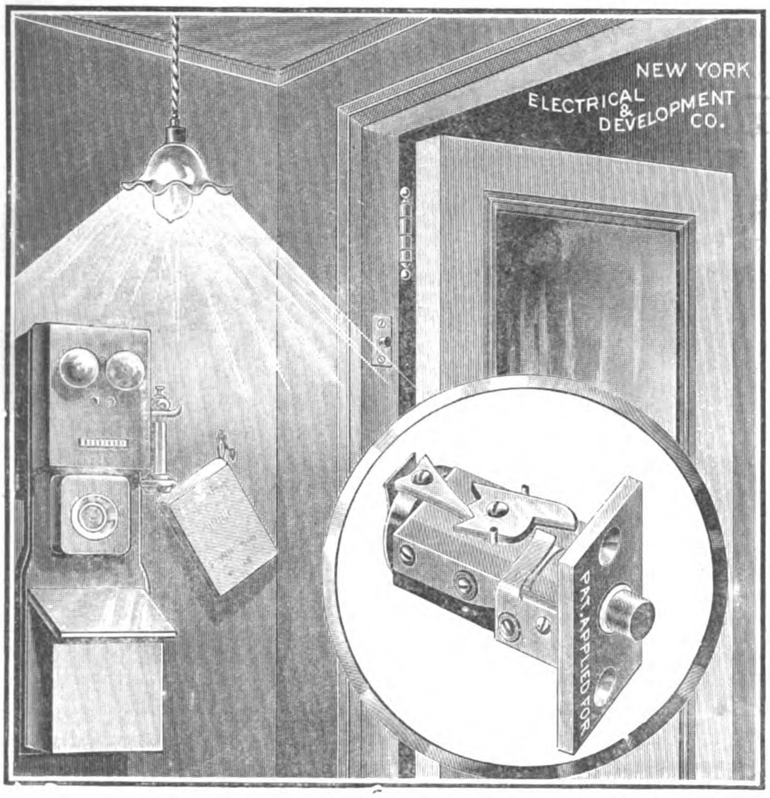
In the Report furnished us of the meeting of the Short Electric Railway Company, of Cleveland, O., it omitted to state that Wm. Hazelton, 3d, was appointed the Assistant General Manager of the company. He has already been in the service of the company for some time.

Brush Electric Company.—L. W. Bradley, who has been for the past five or six years Purchasing Agent of the Brush Electric Company, has resigned his position. H. J. Wendorff, who has had charge of the Brush stock-rooms, has been appointed in his place.

THE SLOCUM AUTOMATIC DOOR SWITCH.

The ease with which electric switches can be made to automatically accomplish many operations has resulted in their application in large numbers. This is well exemplified in the burglar and other alarm systems in which the opening of a door or window is at once signaled by an automatic switch. In such switches, as heretofore made, the opening of a door, for instance, would light a lamp or ring a bell as stated, but, upon the closing of the door the light would again be extinguished and the bell cease ringing. But frequently it is desirable to have light in an apartment upon entering it, which light shall be maintained as long as the apartment is occupied, but shall be automatically extinguished when the room is deserted.

A switch to accomplish this desirable object has recently been invented, and is now manufactured by the New York Electrical and Development Co., and its operations will be readily understood from an examination of the accompanying engraving. As will be seen, the switch is intended to be inserted in the jamb of the door; the knife-blade which closes the circuit between the spring contacts is operated by a tongue attached to a rod against which the door presses upon closing, and which moves in and out as the door is opened and closed. This tongue, it will be seen, engages with two V-shaped grooves at the upper end of the switch-knife; thus, when the door is opened the tongue moves forward and closes the switch, and the lamp in the room is lighted. As the door closes behind the person entering, the tongue is again moved forward out of contact with the knife-blade and remains so as long as the door is closed. Upon opening the door to leave the room, the tongue moves forward again, is pressed into the other groove of the knife-blade and releases it from between the contact clips, breaking the circuit, and extinguishing the lamp.



The Slocum Authomatic Door Switch.

The simplicity of the device by which these successive operations are accomplished is worthy of note. The switch is adapted for rooms, closets, cellars, and indeed for all situations where light is required during the occupancy of the apartment.

The Slocum switch is owned and manufactured by the New York Electrical & Development Co., 251 and 253 William street, New York, of which Mr. E. S. Boggs is general manager. This company manufactures all classes of novelties, and is thoroughly equipped for the working-out of the ideas of inventors, and well organized for placing their inventions on the market and pushing their sale actively.

Messrs. Stanley & Patterson, of this city, are sole agents of the Slocum switch.

Mr. James M. Kearney, for four years the electrician of the Southern Hotel, St. Louis, has entered the combination fixture department of one of the leading electrolier and chandelier houses in that city.

NEW STORE OF DRAKE, PAYSON & WHITTIER, OF PROVIDENCE, R. I.

Cards of invitation were sent out last week to the electrical fraternity in the East, to attend the formal opening of the magnificent new store of Messrs. Drake, Payson & Whittier, of Providence, which happy event took place on Saturday. The invitations read from 4 till 10, and between these hours many hundreds of the company's warm friends and customers gathered in the new premises and wished the members of the company, who were all present, a successful and prosperous career. The new store is on the ground floor of a new block on Weybosset street, conveniently near the Narragansett Hotel, and extends through to the back of the building, being about a hundred feet long by thirty feet wide. In front are two well-filled show windows, in which were tastefully displayed samples of the more attractive electrical goods. In one of the windows was also displayed a handsome floral offering from the Pettingell-Andrews Company, of Boston, and another equally attractive from the Eddy Electric Manufacturing Company, of Windsor, Conn., while inside another beautiful display of flowers showed the thoughtfulness of the employees of the company. One side of the store is almost exclusively devoted to the display of Eddy motors, for which this company is agent in Rhode Island, about a dozen of various sizes being all set up, connected to rheostats and switches, and ready for running at a moment's notice. No better display of motors can probably be seen in the country than in this store. On the other side of the store, are well-filled shelves containing almost every kind of electrical supply, while in the centre are long tables supporting glassware, shade holders, etc., and the more delicate adjuncts of the electrical supply business. In one portion of the room is a handsomely decorated dark room for displaying the lighting effects of all kinds of electric chandeliers, so that customers, even in the day time can select judiciously and can judge of their appearance when illuminated. The offices of the company are in the rear, consisting of ample business office, and suitable private rooms, handsomely fitted up, and well appointed for the transaction of business.

In the evening Messrs. Drake, Payson and Whittier, entertained their friends to something more substantial than the electrical feast provided in the afternoon, with some choice viands and a punch bowl of such generous capacity and high voltage, that a number of our friends present were glad to think as the evening wore on, that they could afford to trust themselves for the night to—*Providence*. It was the unanimous opinion that the company were to be congratulated upon their enterprise in opening such a magnificent emporium for the display and sale of electrical apparatus, and the heartiest good wishes of all present were cordially tendered.

WORLD'S FAIR NOTES.

The Ball & Wood Company, of New York, is the first to have its exhibit complete in Machinery Hall, under the supervision of their Engineer, Mr. Wyckoff, and it is already attracting much attention. It consists of two standard simple engines of 150 h. p. each; two 150 h. p. tandem compound engines, and one 200 h. p. cross compound engine. These engines are connected with Brush dynamos. The business of the Ball & Wood Company in Chicago will be conducted in its own name with Mr. W. B. Pierson and Mr. Thomas C. Perkins, as associate managers; Mr. Pierson having in his special charge the business connected with the large vertical engine this Company is now bringing out, while Mr. Perkins will give his attention to engines of the horizontal type.

NEW YORK NOTES.

Lundell Fan Motors. The Interior Conduit & Insulation Company are now putting on the market their "1893" type of Lundell fan motor which embodies a self-oiling and self-aligning bearing and a new design of fan guard, giving the outfit an artistic appearance. The black japan finish is also a strong element of popularity, and the whole motor is a good exposition of ingenuity and skillful adaptation of means to ends.

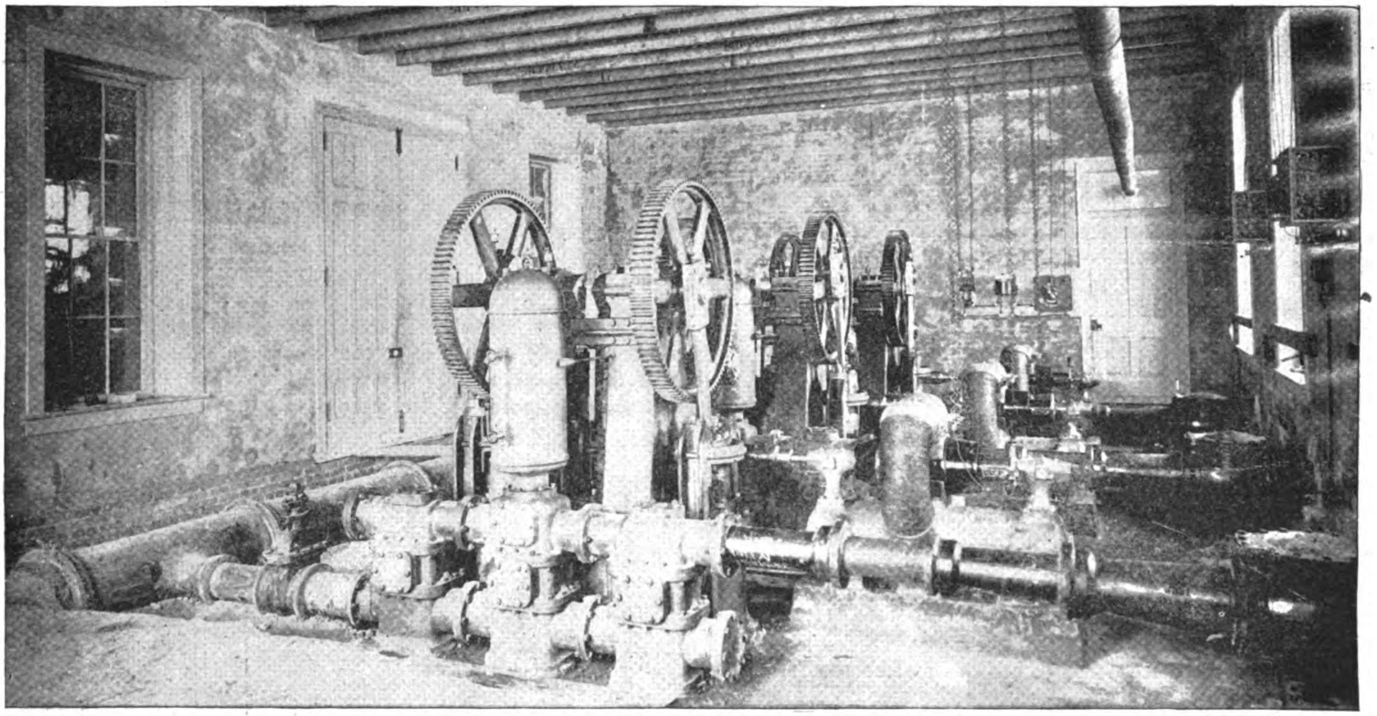
Knight Bros., the patent lawyers, burnt out in Temple Court, have removed to the new Fulton Building, Fulton street, and Nassau.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.
Vol. XV. APRIL 26, 1893. No. 260.

OPERATING THE SAN ANTONIO, TEX., WATER WORKS BY ELECTRIC MOTOR.

An interesting and important city electric pumping plant was installed last January by the Goulds Manufacturing Company, of Seneca Falls, N. Y., at San Antonio, Tex., for the Water Works Company of that city. Our illustration represents the inside of the pump house. The plant consists of three large triplex pumps known as Goulds "Fig. 920." These pumps are duplicates, each having three out-side packed plungers, 10 inches in diameter x 12-inch stroke. Each pump is connected by gearing to a 30 h. p. 500 volt C. & C. Standard motor. The combined capacity of these pumps is 2,250,000 gallons per day.



THE ELECTRIC WATER WORKS OF THE CITY OF SAN ANTONIO, TEX.

The pump house is on Market street in the business part of the city and the water supply is from four 8-inch artesian wells flowing into a standpipe. The water rises in the standpipe to a height of about 45 feet, giving a pressure of 19 pounds at its base.

At the left in the illustration is seen a 20-inch pipe which is connected to the standpipe that is just outside of the pump house. The water flows from this pipe to each pump through a separate valve and is discharged through the 10-inch check valve shown at the right, into a 20-inch pipe connected with the city mains.

The plant is intended to supplement the city supply. The two other pumping stations are at a considerable distance, being about three miles from the business centre, and the water pumped by these electric pumps put into the mains in the immediate vicinity of the principal buildings, will materially help to keep up the pressure in case of fire.

The four wells are from 840 to 870 feet deep and are all within 100 feet of the pump house. The water flows clear and sparkling, and gives to San Antonio the distinction of having the purest and most abundant water supply of any place in Texas. In the case of an epidemic such as cholera, the supply could be cut off at the head of the river and taken entirely from these wells, excluding any possibility of pollution of the city water.

The power is taken at present from the Electric Light and Power Station, but eventually the water wheels which run the pumps at the head of the river stations, may be used to run electric generators and the power be transmitted electrically to the city stations.

Mr. George W. Breckenridge, president of the Water Works Company, is a thorough business man and has always shown himself willing to keep fully abreast of the times in introducing improvements. He was the first to use electricity in San Antonio, having installed a small dynamo several years ago which still furnishes current for the lights throughout his fine residence. In this plant the Water Works Company has the first of its kind and the largest water works pumping station operated by electricity in this country. We confidently expect to see many others operated upon this plan.

LONG DISTANCE TRANSMISSION FROM THE SNOQUALMIE FALLS, WASH.

Snoqualmie Falls, Wash.

One of the latest of the long distance current transmission schemes in the far West is that for the utilization of the Snoqualmie Falls, in the new State of Washington. A view is here given of the main fall, a beautiful sheet of water making a plunge of 268 feet. The total head of water is 275 feet from slack water in the river above to a short distance below the Falls, at a point where there is level ground suitable for a power house. During the ordinary stage of water in the river there is a flow of about 1,700 cubic feet per second. In extremely dry weather the flow may be reduced for a short period to about 1,200 cubic feet per second; while in extremely wet weather there is probably a flow of not less than 4,000 cubic feet per second. This will produce about 32,000 h. p. for most of the year. The highest water is through the winter up to June; the lowest water is in August and September. The distance from Seattle, the prosperous city growing up so rapidly in Washington, is 23 miles as the crow flies. This, however, is over a hilly country, through dense forests and across two lakes, making five miles of cable necessary. To go the distance by the most practicable route around the head of these lakes, is, it is asserted, 40 miles. At present there is no call for power or light of any consequence between the Falls and Seattle, as the region is still largely unoccupied. It will be seen that the conditions for a successful transmission are not as favorable from the economic standpoint as they might be. The population of Seattle is 60,000.

In order to ascertain the local aspect of the case, we have obtained a few figures from Dr. E. C. Kilbourne, president of the Union Electric Company of Seattle. He informs us that the total amount of power being used at present in operating lights, stationary motors and street railways is about 5,000 h. p. There are 102 miles of electric and cable railway; about 1,200 arcs, 12,000 to 15,000 incandescents, and several stationary motors.

Dr. Kilbourne states that the average price for a term of years for slack coal in Seattle has been $1.25 per long ton, switched on the track at the power house. This slack is from lignite coal, with the following analysis: Moisture, 2.12; volatile combustible matter, 46.70; fixed carbon, 43.90; ash, 7.15; sulphur, 0.13.

It would appear, therefore, that the prospect of using all this great power at once and profitably, is not such as to make the scheme as hopeful as some others of the same character. At the same time, the region is a fine one, capital and population are flowing in, and the availability of water power on a large scale always acts as a strong attraction. With such wheels as those which have already done so much to utilize water power in mining operations in the West, the Snoqualmie Falls transmission may yet enjoy the reputation of a fine piece of engineering enterprise.

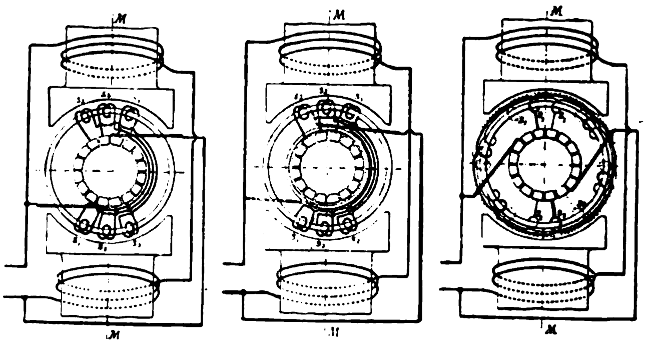
THE ELECTRIFICATION OF GASES BY FRICTION ON METAL.

The question whether gases become electrically charged by friction against metal has been taken up by many investigators, some of whom have answered in the affirmative and some in the negative. The experiments of Faraday and Sohuke among others are so far open to objection, that the gases were not sufficiently carefully dried and filtered from dust. In a series of experiments, K. Wesendonck took air, compressed to 100 atmospheres pressure, also pure oxygen supplied by the Elkau compressed oxygen factory (Berlin), and liquid carbon dioxide supplied by the Berlin Carbonic Acid Company.

The method of experiment was in general that of Faraday. The tube through which the gas was forced out of the holders had an enlargement in the form of a funnel, in which a metal plug fitted, which was connected to the electrometer. Funnel and plug were in a tin box. Air which contained moisture and dust was found capable of being highly charged by friction on metal; but this property became as small as one pleased if the air were thoroughly dried and filtered; so that it may be assumed that with pure air there would either be no effect at all, or very little. Oxygen was found to behave similarly to air in the purified state. Liquid carbon dioxide charged the metal positively, but in the gaseous form was not found to be affected by friction.

A NEW DERI ALTERNATE-CURRENT MOTOR.[1]

A new alternate-current motor has been constructed by Max Déri on the principle shown in Figs. 1 and 2. The armature coils are not all connected together, as in the case of the direct-current dynamo, but the two ends of a coil (or parallel or series group, which is symmetrically placed in the field, such as s_1 s_2 in Fig. 1) are connected to two corresponding collector sections and insulated from all the other coils and sections. The coils or groups of coils so arranged come one after another into contact with the brushes, two or more such groups being put in parallel as the brushes pass the sections; it is said to be a good arrangement to send current into several of the circuits at once, but the circuits must be such as to have about equal E. M. F. Fig. 3 shows an arrangement by which the circuits are spread nearly evenly over the armature, which is desirable; the arrangement is self-explanatory; the current causes consequent poles at the points where it enters and leaves.



Figs. 1, 2 and 3.—A New Deri Alternate-Current Motor.

The principle is the same as that of an old arrangement of Déri's; it consists in reversing the winding at points equidistant from both leading-in and leading-out points—in this case the armature is divided into twice as many portions as there are magnet poles—and the result will be noted that the consequent poles are now formed at those reversing points at which the leading-in and out wires are not joined on. It will be noted that since, in these methods of construction, the armature coils are always in parallel, the simplification indicated in Fig. 2 becomes possible—viz., that one end of each circuit can be joined to a common collecting ring or similar arrangement of some kind.

In all these forms the working current flows through the coils so placed on the armature that the poles hereby caused are in such a position as regards the field poles as to produce maximum torque. It will be noted that since the armature coils are only intermittently traversed by current, it is possible to use a correspondingly higher current density than is allowable in the case of a direct-current dynamo or motor for the same amount of heating; and this fact enables a high efficiency to be obtained in spite of the fact that a portion of the armature is lying idle.

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[1] Abstract from the *Zeitschrift für Electrotechnik*, March 1, 1893.

THE STANLEY AND KELLY TWO-PHASE ALTERNATING MOTOR.

While the progress of electric lighting, especially in this country, has been greatly facilitated by the introduction of the alternate current system, the fact nevertheless remains, that so far as power distribution by the alternating current is concerned, that system has, up to the present time remained an open one; but signs are not wanting that we shall in a very short time see a development in this field which may equal, if not surpass, that of the continuous current motor itself. We have in the past described a number of alternating motors in the columns of The Electrical Engineer, and are now enabled to place before our readers the latest product in this field, the Stanley and Kelly two-phase alternating motor, the result of the joint labors of Mr. Wm. Stanley, Jr., and Mr. John F. Kelly. At the invitation of the Stanley Electric Manufacturing Company we visited Pittsfield, Mass., and were given every opportunity for inspecting not only the operation of the motor itself, but also the process of manufacture.

Before entering into a detailed description of the Stanley and Kelly machine, it may be well to point out the problem which these gentlemen had set before them, and which has resulted in the design of a machine such as we find it. In the first place, they had come to the conclusion that, in order to find the largest scope for immediate usefulness an alternating motor must be adapted to be run with the number of current alternations which is in general use at the present time in this country, namely, 16,000 per minute. With a motor of this kind nothing would stand in the way of connecting all types of electrical apparatus, whether incandescent or arc lamps or other devices, to the feeding circuits, and thus obviating the necessity of running a separate circuit for each individual type of apparatus. It was also discerned by them that a successful commercial motor must be able to start from rest with a torque or turning moment sufficient to overcome the usual resistances of line shafting, etc., and thus do away with the necessity of bringing the motor up to synchronism before applying the load. It was this fact that determined them in constructing a non-synchronous type of motor designed to start with a powerful torque, and which regulates with a high degree of constancy so that the speed between full and no load is quite comparable to that of the present continuous current motors.

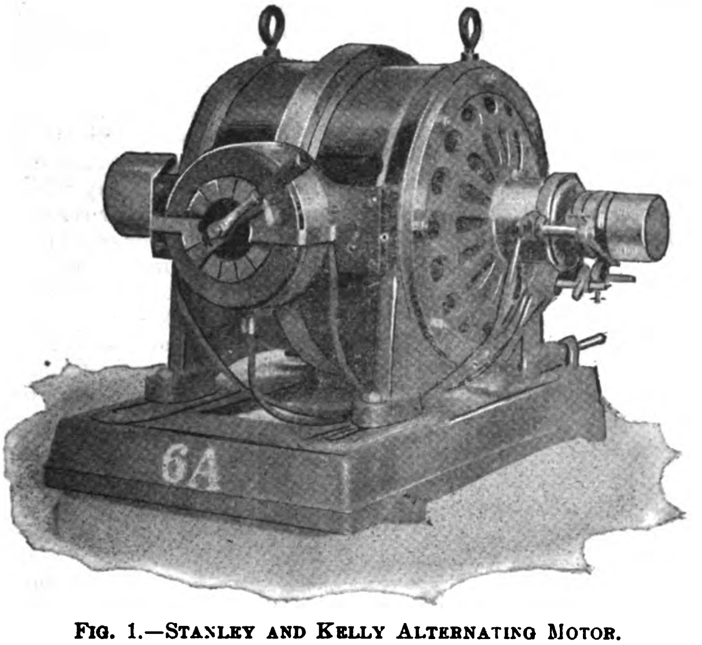
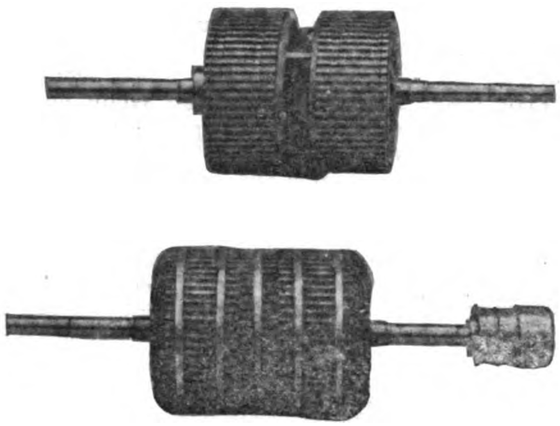


Fig. 1.—Stanley and Kelly Alternating Motor.

Having determined these factors they next turned their attention to the means for regulating the supply of current to the motor so that it shall be proportional to the work done by it, and at the same time overcome the obstacles encountered by the heavy false or "wattless" currents which, though they do not actually consume power, introduce difficulties that are more particularly pointed out below. To carry out this they have adopted the use of condensers in connection with the fields of the motor, and the functions of which will be described presently.



Figs. 2 and 3.—Armature of Stanley and Kelly Motor.

Coming now to the machine itself, our engraving, Fig. 1, shows it in perspective with the starting box attached. As already remarked, the motor is a two-phase machine operated from three wires.

The construction involves what might for simplicity be called a double set of armature and fields. The arrangement of these parts will be readily understood by an inspection of the engravings, Fig. 2 and 3, which represent the double armature unwound, and wound, respectively, and, Fig. 4, which shows one of the sets of fields with two of the coils in position, the rest being removed in order to show the construction of the pole pieces.

Beginning with the armature it will be noted that the two halves are wound in the same manner as if they constituted but a single armature, the winding being of the closed circuit type and, in general, similar to that of the ordinary alternating current generator. Each of the sections of this armature revolves in a field similar to that shown in Fig 4, the two fields being joined together at the middle by means of a flanged casing.

The engravings, Figs. 5, 6 and 7, show an end view of these fields, and two sections, one taken through the centre line of the pole pieces, and the other midway between.

The pole pieces influencing the two armatures are staggered; the result of this is that when the winding on one section of the double armature is having the maximum E. M. F. induced in it, the continuation of the same winding on the other armature is under a strong pole, that is, one at which the magnetizing current strength is at a maximum. There is in consequence a torque action between the armature current generated by the one side, and the field on the other side. A quarter period later the relation of the field circuits is reversed, the active poles falling to zero and becoming current inducers and the previously inducing poles on the other side attaining their full strength. The torque action is now due to the other side of the machine, that in which the poles have now their maximum value.

At every quarter period there is thus a shifting of the torque action from one armature to the other, but the direction of the torque is constant.

It will be evident, however, that the current generated in the armature winding by the inductive influence of the pole pieces would be a lagging current, and that if allowed to lag would result in what might be called a "teetering" action of the armature; that is to say, the armature would be moved in a certain direction by a given current for a given current in one of the sets of pole pieces, but the armature current not changing sign at the same time with the field magnetization, any one current impulse would pull both ways, so that the armature would vibrate back and forth instead of revolving. To prevent this action and to destroy the lag which would otherwise take place, Messrs. Stanley and Kelly have introduced what they term a compensating winding. This winding is shown at A in Figs. 5, 6 and 7 and consists of two copper rings which encircle the ends of both fields and are joined by cross bars which pass through slots in the centre of the pole pieces; these slots are well shown in Fig. 4. It is evident that this compensating winding acts as a secondary of low resistance to the wires on the armature as a primary. The bars in the slots parallel to the pole pieces have no effect whatever on the latter, their only object being, as stated, to influence the action in the armature.

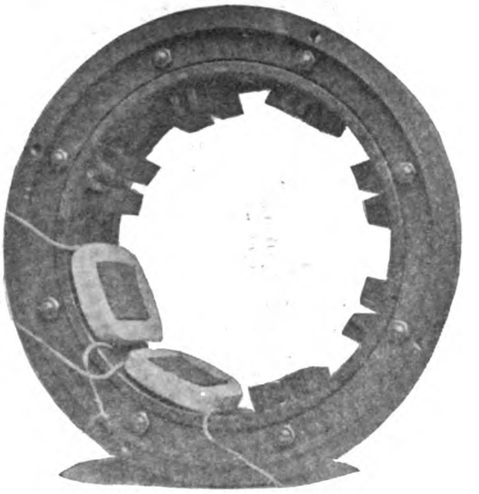
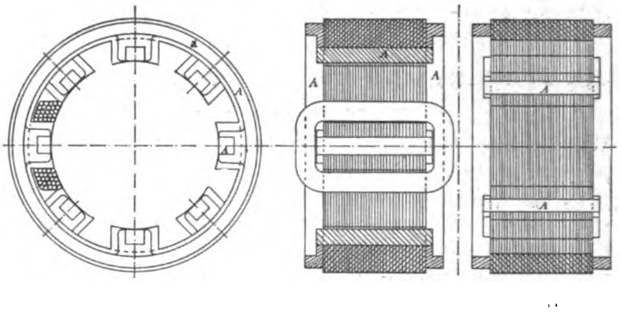


FIG. 4.—ONE SECTION OF THE FIELD MAGNETS.

As we have already pointed out, the armature is of the closed circuit type, and the machine requires no collector after starting in operation. But to facilitate the operation of bringing the motor up to speed with a powerful torque, use is made of a starting box in connection with a collector on the armature shaft. This collector consists of three solid rings connected to the armature and to the starting box in the manner shown in Fig. 8. The starting box consists merely of a rheostat, the resistances in which, when the motor is started are gradually cut-out as the motor comes up to speed; and when finally full speed is reached the entire resistance is cut-out, and the collector sections short-circuited among themselves, thus fulfilling no further function in the operation of the motor; indeed on the smaller sizes of motor where a pull on the belt is sufficient to start the machine, the starting box and collector are entirely done away with. The action of the starting box is indeed quite analogous to that used with continuous current motors, the object being to prevent the sudden rush of current through the armature at low speed.

The field coils are alternately connected to the two sides of the three-wire circuit and receive currents differing 90 degrees in phase. They receive the current from the motor transformer, which is connected to the line as shown in Fig 9, and which transforms the current from 1,000 to 500 volts. Connected in shunt to the field coils are a set of condensers, the functions of which are evidently to neutralize the self-induction of the field coils, by supplying a current equal to the lagging component of the current in the coils, thus reducing the current drawn from the transformers and generator to about that corresponding to the energy expended, and so avoiding the excessive demagnetization and consequent bad regulation of generator and transformers.



FIGS. 5, 6 AND 7.—END VIEW AND SECTIONS OF DOUBLE FIELDS.

The action of the condenser can, perhaps, best be illustrated by reference to the results of a series of tests made upon a 2 A machine of this type, Fig. 10. It will be noted that without condenser at full load the volt amperes indicated was 3,900; with the condensers in circuit the apparent energy consumed was 2,540 volt amperes; while, the actual energy was 2,258 watts. This shows a difference in the apparent energy consumed of more than 50 per cent. in favor of the condensers. It also brings out another very important fact which will be thoroughly appreciated by central station managers, and that is, that by the employment of condensers the false currents are eliminated, the condensers forming a complete local circuit with the field coils and allowing the lagging currents necessary in the latter to circulate freely, but precluding them from reacting on the converter. To give a concrete example we may mention that a 7 h. p. motor without condensers in circuit requires six amperes on each side to operate it, supplied from the transformer; with the condensers in circuit each side requires only 1.8 amperes at 16,000 alternations. Without condensers, therefore, the line circuits as well as the converters would have to be proportioned to carry currents nearly three times as great as are actually necessary when condensers are employed, so that if for no other reason, their application is thus shown to be essential for economy. It is true that these false currents consume no actual energy, but their transmission must be provided for in order to prevent undue loss in the conductors, and they also require increased size in generators and converters.

The condensers employed are contained in two separate boxes placed close to the motor. They are made up of slabs, 8 x 12 x ¼-inch thick, placed in tin boxes; eight of these slabs are required for a 1-h. p. motor, 10 for a 2-h. p. motor, and 22 for a 5-h. p. motor. Each slab is built up of 50 sheets of tin foil insulated by a special process and thoroughly tested before being put out commercially. The efficiency of these condensers is remarkably high, the loss in the dielectric not exceeding 1 per cent. In measuring

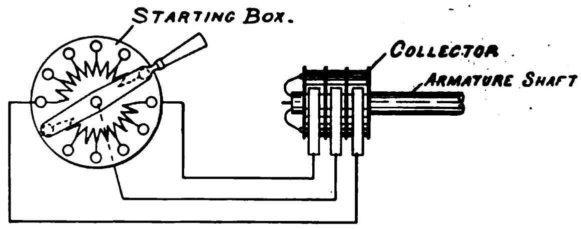


FIG. 8.—CONNECTIONS OF STARTING BOX.

this loss, use has recently been made of Mr. Edward Weston's new direct reading wattmeter which confirmed in a remarkable way the results obtained by the previous more complicated methods. Each of these slabs is capable of transmitting .35 ampere at 500 volts and 133 periods per second, that is, at 16,000 alternations per minute. These condenser slabs, as already stated, are encased in small boxes, and each section is provided with a safety fuse.

Although operating non-synchronously the regulation of these motors is highly satisfactory for the smaller sizes, while those above 5 h. p. exceed in closeness that of continuous current machines; the 6 h. p. machine for instance scarcely dropping 10 revolutions in 2,000, while the 2 h. p. motor, Fig. 10, up to the point of full load compares fairly well with that of continuous current motors of the same size.

In order to thoroughly demonstrate the practicability of this type of motor, the Stanley Co. have had a number of them in operation in Pittsfield for the past six months, and for two months past current for the motors has been supplied from a two-phase 60 k. w. alternator at the station of the Pittsfield Electric Co., which machine has taken the day load of the station. Besides furnishing thirty customers aggregating 450 lights, it also furnished the current for no less than six motors aggregating from two to 10 h. p. in the various shops of the Stanley Electric Manufacturing Co., and a 10 h. p. motor in the woolen mill of the Pittsfield Manufacturing Co. The latter is at a distance of more than half a mile from the central station, and was visited purposely in order to note the operation of the machine when placed in the hands of the customer. The motor was found to work very satisfactorily, and the machine, boxed up in a corner, receives practically no more attention than would be bestowed upon a converter hung outside the wall.

The simplicity of the system from a central station standpoint will be apparent from an inspection of the diagram, Fig. 9. By the employment of a two-phase machine and three wires, all that is necessary is to disconnect one terminal of the lighting converter and attach it to the third wire, no separate converter being necessary where lights are employed. Where a motor is used a separate transformer is put in from which connections are made to all three wires of the circuit. These transformers reduce the potential from 1,000 to 500 volts. The potential existing between the outside wires and the middle wires is 1,000 volts, but that between the two outside wires is 1,400 volts; as a result, the total weight of wire necessary in a system of this kind is 25 per cent. less for given output and line loss, than with the ordinary single-phase system. Of course, in running three-wire circuits of this kind it is desirable to distribute the load on each side of the circuit as much as possible, but the balance need not by any means be a delicate one, and indeed the disproportion may be considerable without in any way affecting the integrity of the system. Of course, it goes without saying that a two-phase machine is just as well adapted for lighting as a single-phase machine, so that on this score there need be no hesitation on the part of station managers to the adoption of two-phase machines. But the added income available from the supply of power furnished by three-wire two-phase circuits will probably more than compensate for the extra expense entailed in making the change.

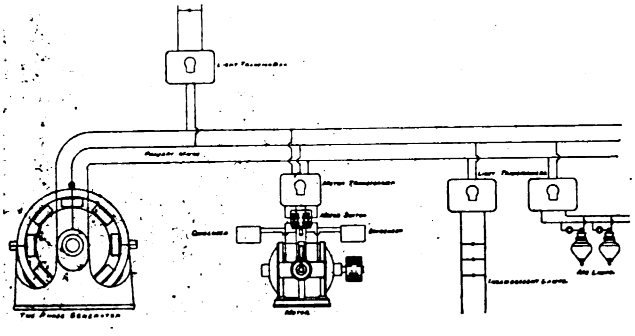


FIG. 9.—ALTERNATING CURRENT TWO-PHASE SYSTEM FOR POWER AND LIGHTING.

In employing a frequency of 16,000 per minute, Messrs. Stanley and Kelly were merely contending with the conditions such as they were found at the present time, but they well recognize the fact that where central stations are about to start in operation the use of a lower frequency of, say, 60 or 65 periods per second, would be more desirable, as the total efficiency of the system would be thereby increased over that of 133 periods, although, of course, the reliability of operation is alike in both.

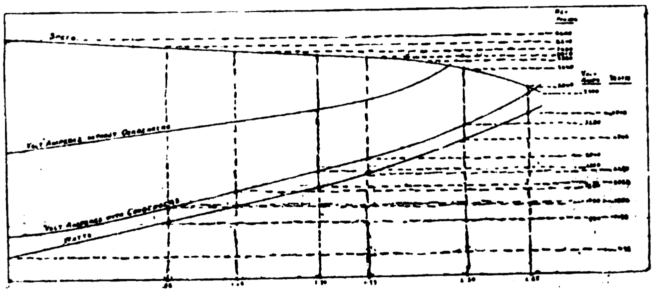


FIG. 10.—DIAGRAM OF TESTS, 2 H. P. STANLEY & KELLY ALTERNATING MOTOR.

The mechanical construction of the machine has been well worked out, and self-oiling bearings make it unnecessay to attend to the motor for long periods at a stretch. Up to the present the machines have been constructed in sizes varying from 15 h. p. down, and work is now rapidly going on looking towards the building of larger sizes.

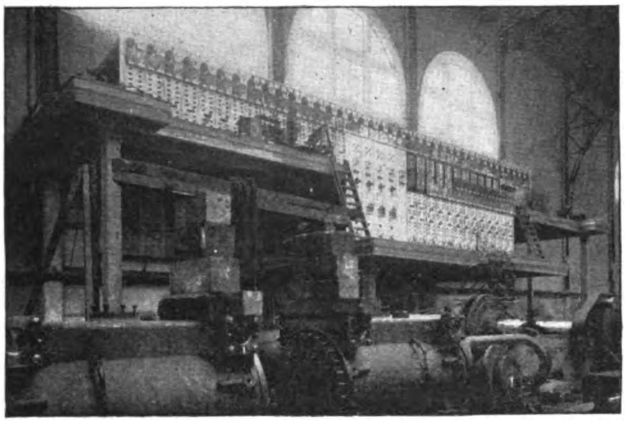
APPARATUS FOR PERFORMING THE TESLA EXPERIMENTS.

In performing the Tesla experiments, Prof. M. Schoentjes of the University of Ghent, Belgium, employs a single induction coil connected with a vibrator. The coil is 40 by 20 centimetres, and the energizing current is furnished by a number of accumulators. With this arrangement he produces the following phenomena: (a) Both ends of the secondary remain open. 1. A Geissler tube, with or without electrodes, glows if held in the hand of the experimenter or placed upon a block of paraffine at a distance of thirty or forty centimetres from the coil. 2. The same result is obtained if the tube is held by the experimenter, with one end touching one of the terminals of the secondary; a contact is not required. 3. The same phenomenon is observed when the tube is placed on a block of paraffine, touching with one of its ends one terminal of the secondary coil. (b) Leave one of the terminals of the secondary open, and attach the other to a sheet of iron suspended from the ceiling by a non-conductor. 1. Connecting the open terminal to a vacuum bulb having one electrode and a rectilinear carbon filament, the latter glows. 2. A Crookes tube prepared with phosphorescing powder glows when the experimenter holds it below the suspended sheet of iron. 3. The tube becomes luminous when placed on a block of paraffine below the iron sheet. (c) The two terminals of the secondary are connected by a metallic conductor having a spark gap. A vacuum tube glows in the neighborhood of the coil. Using the same arrangements as described under (c), but connecting one of the terminals to the metal sheet, it is found that vacuum tubes glow if placed either directly under the metal sheet or near it. These experiments succeed at such a low rate of vibration as five oscillations per second, and using a much smaller inductorium than the coil the dimensions of which have been described.

WORLD'S FAIR DEPARTMENT.

LIGHTING THE WHITE CITY.

The Westinghouse Electric and Manufacturing Company are doing a very great deal of hustling just at present to get their enormous power plant in Machinery Hall ready for service by the 1st of May. This plant, it will be remembered, is to supply current for practically all the incandescent lamps on the grounds, that is to say, all those that will be used for actual service-lighting, and it is therefore highly important that there should be no delay in starting. Judging from present appearances, there seems to be no reasonable doubt that they will succeed. Everything is going like clockwork and order is being evolved from apparent confusion with a rapidity that reflects the highest credit on the engineers in charge. The boilers are already in and many of them are in daily use, but as they are common to all exhibitors in this building and form no part of this special plant, they will not be touched upon here except to say that the management is seriously considering clothing the firemen in evening dress to show how absolutely free from dust and dirt the room can be kept. It is to be sincerely hoped that this only applies to the hours after six in the evening, and that they will be careful to provide the men with proper morning and afternoon garb as well, of the most approved Craven style.



Westinghouse Switchboard in Machinery Hall.

The plant proper occupies a wide stretch at the southern side of the main building extending west from the central dome. It consists of 12 two-phase alternating 2,000 volt generators, each having a rated capacity of 1,000 h. p., but being readily capable of delivering 1,500 h. p. when required. These are divided up into groups driven by engines of different makes, and will be so taken up and described.

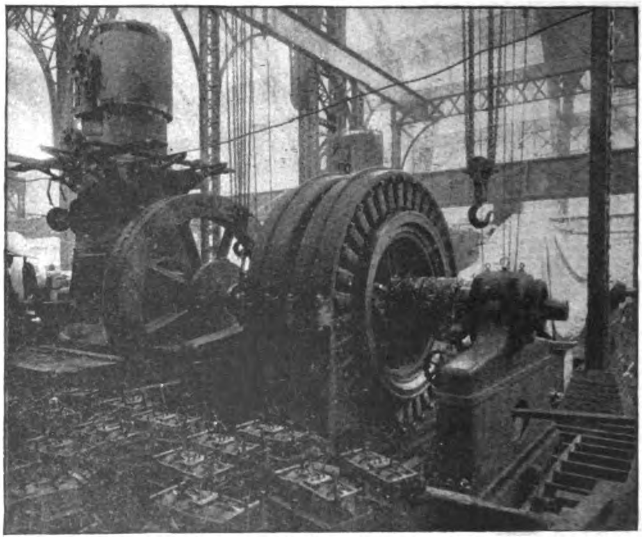
The first group consists of six generators driven by direct connected 1,000 h. p. Westinghouse compound engines, each of which weighs, complete with wheel, 65 tons. These are under the supervision of Messrs. F. M. Rites and A. S. Mould, engineers-in-charge. These six units are arranged in two sub-groups, of four and two respectively, the former placed side by side with their shafts parallel at uniform distances of 24 feet between centres, and the latter stand a short distance away with their shafts in line with one another. Each engine has the customary iron gallery running around the upper part and between these extend connecting galleries in each group, giving a still greater appearance of unity to the whole. Instead of a separate foundation for each unit, there are but two; one for each group. The larger of these is of concrete 100 feet long by 35 feet wide, while the other, also of concrete, is about half this size.

The engines stand 17½ feet high from their foundations. The cylinders are respectively 21½ and 37 inches in diameter with a 22-inch stroke, and the speed will be no less than 200 revolutions per minute, a radical departure in practice with engines of so great a power. They are not to be speeded up for this especial purpose alone, but are designed for a rate of 200 revolutions as normal, and will be so operated. In fact, even this gives less piston speed than is allowable.

Each engine is supplied with an independent complete condensing plant. Two of these will consist of Wainwright surface condensers with Deane pumps, two of Wheeler surface condensers with Knowles pumps, while the remaining two are of the Worthington jet pattern supplied by Worthington pumps.

The engine shafts are 13 inches in diameter, and besides being aligned with the generator shafts to the thousandth of an inch are connected to the latter by means of a flexible coupling which will allow considerable displacement without appreciable strain.

An interesting piece of mechanism used in connection with these engines is the "inertia balance." The valve gear weighs about 1,000 pounds, and with its momentum at so high a speed would exert a pressure on the governor, it is estimated, amounting to 2½ tons. The inertia balance, therefore, has been devised for resisting this pressure by means of an air cushion, and leaving the governor free for regulation and without strain. All the valves, etc., are so placed that the attendant can reach them without changing his position.



1,000 H. P. Westinghouse Generator Direct Driven by Westinghouse Compound Engine.

The second group consists of two generators, tandem-belted, driven by a 2,000 h. p. quadruple expansion Allis-Corliss engine, running at 60 revolutions per minute, standing on a foundation 57 feet 6 inches long, 28 feet wide and 13 feet 9 inches deep. The cylinders are 26, 40, 60 and 70 inches in diameter respectively, and have a stroke of 72 inches. The maximum capacity of this engine is 3,000 h. p., though it is rated at 1,000 less. It is provided with 36—16 Allis air pumps, driven by a Reynolds-Corliss cylinder. The three receivers are placed beneath the floor and nothing except the necessary piping is visible above, where it is so arranged that the two sides of the engine may be run as two distinct compound engines if desired. The fly wheel weighs about 50 tons and is 30 feet in diameter with a 76-inch face. It is made in 12 sections which in addition to being bolted together, have links sunk into their outer edges for additional security. The whole engine complete weighs about 300 tons. The frame is of Mr. Edwin Reynolds' 1890 pattern and is wholly of cast iron. The receivers and cylinders are all steam-jacketed, and the latter are provided with $\frac{11}{12}$ Reynolds-Corliss cut-offs; those on the two larger being regulated by hand and the others by governor.

A special Chapman throttle valve is used having a by-pass for convenience when it is desired to admit a very little steam for any purpose, and the steam for the low pressure side, when the engines are run compound, is passed through a reducing valve. The cross head is also an unusually strong and solid affair. At one end it is made in one piece while the strap at the opposite end is secured with two gibs and a single key.

3,000 H. P. Reynolds-Corliss Engine in Westinghouse Generating Plant.

It may be added that the shaft is 17 feet long over all with a disc crank at the end. It is 21 inches in diameter in the centre with 19-inch bearings, 32 inches long.

The remaining four generators are driven respectively by a McIntosh & Seymour, an Atlas Corliss, a Buckeye, and a Fraser and Chalmers' engine, each of 1,000 h. p. Of these only the Buckeye is in a sufficiently advanced state of erection to obtain satisfactory data. This is a triple-expansion high-pressure engine, with a 20-inch high pressure and a 32½ intermediate cylinder and two 36-inch low-pressure cylinders, with 48 inches stroke, running at a speed of 85 revolutions per minute. The shaft is 16 feet long with journals 13 inches in diameter and carries a five ton band wheel, 21 feet in diameter, with a 74-inch face. Wainwright surface condensers supplied by a Conover pump are used with this engine and are stowed away in a pit between the cylinders. There are also two combined Wainwright reheaters and receivers.

In addition to all these there are two 500 h. p. alternating-current generators direct-connected to Westinghouse compound engines, and the exciting currents are supplied by three "Kodak" generators delivering 300 amperes each at 250 volts, also direct-connected to a Westinghouse compound engine. Besides the lighting plant the Westinghouse Company are putting in a 500 h. p. slow speed multipolar, direct-current generator for the various motor circuits, direct-connected to an Allis-Corliss engine. This installation is also at present in a rather embryotic state.

The output of this enormous plant is distributed from a marble switchboard consisting of two distinct parts, *i. e.*, the dynamo board and the feeder board.

The dynamo board is 32 feet long and 11 feet high, and consists of 18 panels, 13 distributing the output of the generators to the feeder board and the remaining five taking care of the exciting current. Of the 13 dynamo panels, 12 handle the 1,000 h. p. two-phase generators, while the 13th takes the two 500 h. p. machines. At the top of each panel are placed the Westinghouse voltmeters and ammeters. Below these come the switches, while at the bottom are the rheostats. The five panels of the exciter distribution board are arranged as follows: Four contain each an ammeter, an automatic circuit breaker, a switch, a voltmeter plug socket and a rheostat for a single exciter; the fifth panel contains the main ammeter and voltmeter.

The feeder board, 71 feet long and 9½ feet high, distributes current from the dynamo board to 40 different circuits and has a separate panel for each. These panels contain the Stillwell regulators for feeder regulation, the switches and the measuring instruments. The circuits pass through the subways, already fully described in The Electrical Engineer, to the various buildings. A very attractive feature of the board is that for the high potential currents no points of contact appear on the outside, the switches being placed at the back of the board and having long insulated handles passing through openings to the front. Every panel of both boards has its pilot lamp at the top which adds greatly to the beauty of the whole, and the board itself, standing as it does high above the surrounding machinery and apparatus will be one of the most striking and conspicuous objects in the Palace of Mechanic Arts.

THE ELECTRIC LAUNCHES AT THE WORLD'S FAIR.

The long-talked-of electric launches have begun to arrive at Jackson Park and may now be seen making their trial trips; shooting silently from point to point with no visible means of propulsion, and so carefully designed that they do not even have a wake and scarcely ruffle the water through which they pass. They are beautiful boats (as illustrated in The Electrical Engineer of April 5, page 350), with polished brass fittings and graceful lines and lend a delightful air of animation to the lagoons.

There will be 55 of these little craft in service during the summer, and 25 are already in commission. Of these 55 all but four will be for public use and will run at a speed of six miles an hour, which is all the Exposition authorities will allow. The other four are set apart for the use of the Fair, and have a normal speed of seven miles an hour, but can, when desired. be spurted at the rate of from 12 to 14 miles. Each launch has a seating capacity of 30 people beside the pilot, who manages the entire boat without stirring from his post at the bow, and the stern deck-hand; and carrying this load, will cover each day, with one charge, from 36 to 40 miles. The total mileage will thus be over 2,000 miles a day. The round trip will be three miles with 15 stops.

LIGHTING THE BIGGEST BUILDING IN THE WORLD.

A special dispatch from Chicago of April 19, says: "A faint idea of the grandeur of the World's Fair at night, when the electric system is in working order, was obtained Tuesday night, when for the first time a portion of the new building was lighted. The corona at the south end of the Manufactures Building was tested with satisfactory results. It is a hundred-lamp ring, half the size of the centre corona, but the illumination generated by it was so intense as to be a blaze of light, which turned night into day for a quarter of a mile about and was visible several miles out on the lake."

ELECTRIC RAILWAY DEPARTMENT.

THE FIRST ELECTRIC RAILWAY IN NEW ORLEANS.—II.

BY

G. Langstaff Johnston

VI.—POWER PLANT (*Cont.*).

Boiler Room.—This room, 51 x 100 x 26 feet pitch contains four Babcock & Wilcox boilers, calculated to carry 125 pounds steam pressure, arranged in two batteries, with heater, hot well, two feed pumps, fire and tank pumps, provision being made on the right for additional boilers in the future. A brick stack, 30 feet high, passes through the roof on which is placed 95 feet of iron stack, 5 feet in diameter, making the total height 125 feet.

Water Supply.—This is taken from two six-inch artesian wells about 800 feet deep, located just outside the boiler-room, next to the river.

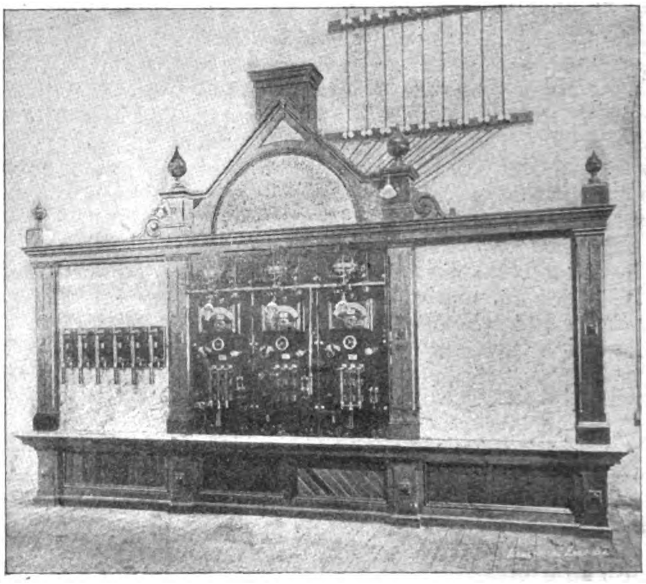
The water from these wells has given good results in the boilers, and is extensively used. The Mississippi river is nearly always muddy and heavily charged with sand, which is injurious both to pumps and boilers; for these reasons it was deemed best to use well water for the boilers and condensers.

The feed pumps are connected to the wells and heater as shown on the plan, Fig. 5, in the last issue of the ENGINEER.

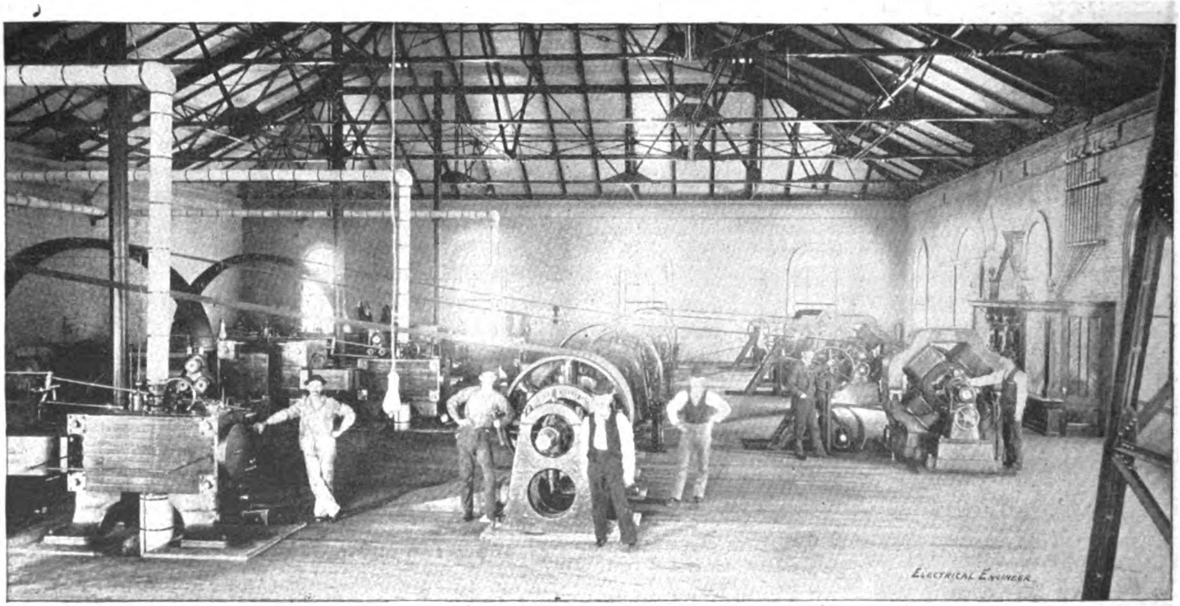
An eight (8) inch pipe is laid to the river which passes over the top of the levee (as required by law) to deep water, and at certain stages of the water in the river will act as a siphon. All the pumps are connected to this pipe, so that river water can be had in case of a stoppage of the artesian wells. It is now being used temporarily, pending the completion of well No. 2.

The Engines.—The power house proper is 85 x 131 x 20 feet pitch, and the boiler-room adjoins it, as shown. It contains three Corliss compound tandem condensing engines with cylinders 16 x 30 inches with 48 inches stroke (with independent jet condensers). They are of 300 h. p. each, built and erected by Messrs. Lane & Bodley, of Cincinnati, O. The fly wheels are extra heavy, weighing 40,000 pounds each, 18 feet in diameter, 34 inches face, and making 70 revolutions per minute. These engines are belted, by 34-inch double-leather Munson belts, to a 5½-inch steel line shaft, with the proper pulleys and friction clutches, speeded to 250 revolutions per minute. The shaft can be disconnected so that each engine can run its own dynamo.

Foundation for engines and line shaft stands were commenced two feet below the surface of the ground. As at this depth composted river sand was found, it was only considered necessary to spread the footings on a double 4 x 12 inch heart-cypress timber cross-laid flooring, so that it would only have to sustain about 800 pounds per square foot. Hard brick, brought by rail from Port Gibson, Miss., and laid in the best Portland cement mortar was used in their construction. The foundations extend 6½ feet above the ground line, to the level of the engine-room floor. The engines are guaranteed, under a duty test, to develop their rated power measured by the indicator, with the consumption of two (2) pounds of Second Pool Youghiogheny coal per h. p. per hour, with an initial pressure of 100 pounds steam. As the boiler house is on the street next to the river, up which passes the Belt railroad, coal is obtainable both by rail and water.



SWITCHBOARD, NEW ORLEANS ELECTRIC RAILWAY.



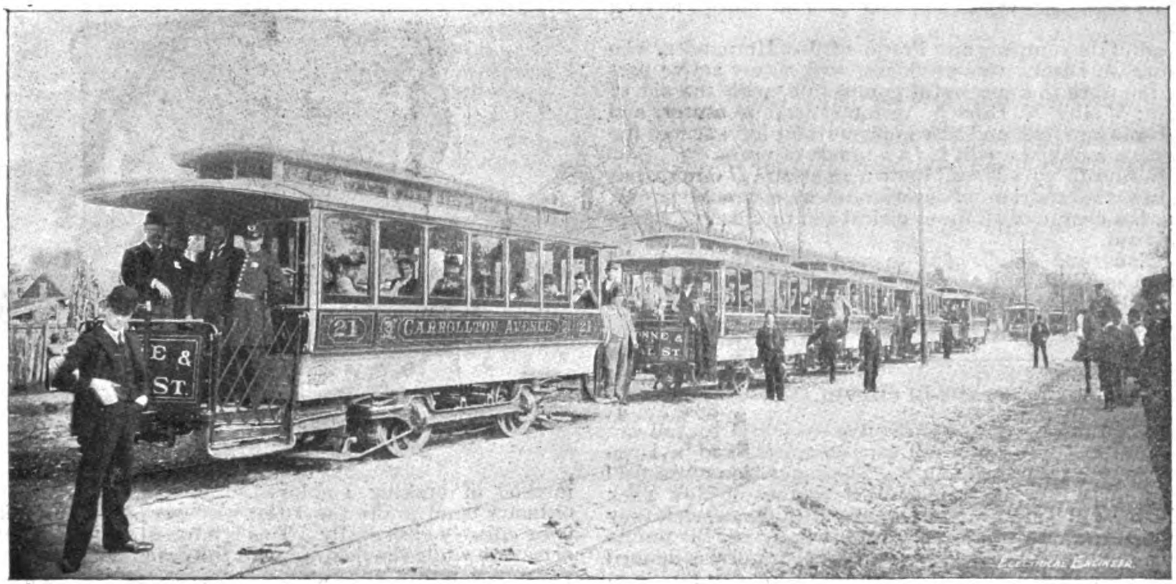
DYNAMO AND ENGINE ROOM, NEW ORLEANS AND CARROLLTON ROAD.

The Steam Piping from the boilers passes through the division wall between engine and boiler-room into a main pipe, 10 inches in diameter, on brackets along the side of the wall. From this pipe each engine receives its steam, the valves being so arranged that any engine can be run from either battery. On the pipe to each engine there is placed a quick stop-valve, worked by a rope from the floor, in case of an accident. It is proposed to work this also by an electrical trip and push buttons placed at the switchboard, at the ends of the room.

The floor of the engine-room is 6½ feet above the ground, and consists of a double 1¼-inch pine flooring cross-laid with two layers of roofing felt between layers. All steam pipes are covered with magnesia covering, put on with brass bands.

Condensers.—The peculiar conditions that exist here of the high-water level of the river being above that of the ground, and the fact that the supply of water for the condensers had to be taken from the river in case of accident to the wells, made the kind and location of the condensers a subject of a careful study. Upon consultation with the builders of the engines and their local agents, Messrs. C. S. Burt & Co. it was decided to use the Buffalo Pump Company's independent jet condensers, that have the condensing chamber set low down on a base plate, and level with the pump. This arrangement allows the discharge to be made at ground level, and permits the condenser to be placed higher without danger of flooding the compound engine cylinder. They are also provided with an automatic stop as a further protection in this direction. They are placed on the ground under the floor, each pump taking its water through a separate 6-inch pipe from the small tank as described below.

The artesian well water is used for the condensers; this is first pumped by a 10 x 12 Smedley steam pump from the well into a 20,000-gallon tank, which in turn supplies a small 2,000-gallon tank sunk into the ground so that its top will be below the bottom of the large one. The condenser pumps take their water from this tank, the supply from the big tank being regulated by valves, worked by floats in the small one. This arrangement further prevents accidents from flooding. To provide against the contingency of a failure of the artesian wells, the boiler feed, and tank pumps, are connected to the 8-inch pipe to the river, so that river water can be used.



Electric Cars on the "Neutral Ground," New Orleans.

The Electric Generators.—These consist of three 200-kilowatt multipolar compound-wound generators with armatures making 425 revolutions per minute, adjusted for constant potential; they are of the latest design of the General Electric Company. They furnish the electric power, which is now easily done with two, the other being held in reserve. They are belted from the line shaft by 22-inch Munson belts. For uniformity and smoothness of running, these generators cannot be excelled.

Switchboard.—This is of a very ornamental and unique design; the frame is made of native cypress in hard oil finish, 16 feet long, with three marble panels, and located in the centre of the west side of the engine-room within easy access. The centre panel contains three sets of controling instruments, one for each generator, on a heavy black-marble base.

This is the recent neat and compact arrangement lately brought out by the General Electric Company, which greatly simplifies the equipment of a switchboard. The side panels are of dark Georgia marble; the left hand one contains six automatic circuit breakers and switches, which control the six feeder systems into which the line is divided. The right hand panel is intended for future increase, which can be easily done by removing the panel, and substituting duplicates of the centre panel. The semi-circular centre panel contains the name of the company and those of the officers, in gilt letters, the whole making a very beautiful and attractive board, which adds a great deal to the appearance of the room.

VII.—CAR HOUSE, WORK SHOP AND GENERAL OFFICES.

The car house, work shop and general offices of the company, are situated at the end of the line in Carrollton. The car house is 265 feet long by 128 feet wide and designed to hold 100 cars. It is constructed entirely of steel and is as nearly fireproof as it is possible to make it. Ten tracks run into it from both ends.

An inspection pit 14 feet wide runs across the whole length of the house, and a working pit 140 feet by 50 feet is located on the west side. The construction of these pits, as the bottoms are well down below the water line, required to be done with the best material and in the most careful manner to render them water tight. Hard brick laid in the best Portland cement, on a three-inch timber foundation was used, provision being made at each end to pump out leakage water.

A complete set of workshops, in every detail, equipped with new and improved tools are conveniently situated on the west side. A transfer table passing in front takes a car from the car house and places it in any one of the shops.

Arrangements for washing the cars is provided for by means of a three-inch artesian well 785 feet deep, which flows to a height of 12 feet. On top of the three-inch pipe, above ground is placed a 12-inch stand pipe. Hose connection are tapped in to this. In connection with the stand pipe a hydraulic ram forces water to an elevated fire tank 40 feet high. In addition to this arrangement, for fire protection fire engines can connect direct to the stand pipe and pump from the well.

As an item of interest it may be mentioned that in sinking artesian wells in this locality, natural gas has been found, and in sinking the well at the power house, the auger brought up pieces of orange trees from a depth of 785 feet.

For the erection of the dynamos and future repairs, the author designed a portable iron hoist which was built by the Berlin Bridge Company. This device answered all the purposes of the usual over-head traveler, at the same time relieving the side walls and foundations of the extra weight that would have been brought upon them. It is a very economical arrangement. It can be easily shifted by two men by applying iron bars to the wheels upon which it rolls and which are provided with holes for that purpose.

The car equipment consists of 50 18½-foot closed cars of the very finest finish that could be turned out by the St. Louis and Brill car companies, 40 being built by the St. Louis Company with the McGuire truck and ten by the Brill Company with their Brill truck. All have a seven-foot wheel base. A 36-inch wheel is used to raise the motors as high as possible from the ground, an account of the great depth to which the streets are flooded during very heavy rains. The electrical and mechanical performance of these motors, under the trying conditions incidental to the inauguration of the first road in a large city, has been remarkable, and have given the greatest satisfaction. The business done by the road is so much larger than anticipated, that the Directory now realize that it will soon be necessary to order more cars.

The St. Louis Car Company is now building a private car for the President, which will surpass in style and finish anything like it that has been recently brought out.

VIII.—THE CONTRACTORS.

The overhead construction was done in a very neat and substantial manner with the line material of the General Electric Company, under contract, by Messrs. J. G. White & Company of New York, with Mr. Jno. A. Wilson in charge, and reflects great credit upon the contractors; this firm also laid the greater portion of the track. The feeder and bond wire, was furnished by the Ansonia Brass & Copper Company.

The contract for the entire steam equipment of the power house, with engines, boilers, line shafting, friction clutches and pulleys, etc., complete, ready for starting, the dynamos, was let to Messrs. Lane & Bodley, of Cincinnati, Ohio, through their agents, Messrs. C. S. Burt & Company, of New Orleans. Mr. Walter H. Cook, agent, furnished the four Babcock & Wilcox boilers.

This plant has so far given entire satisfaction in every respect, and is as complete and perfect as it is possible to make it. It is now under the contract test and from present indications the contractors are confident of exceeding the duty called for. The steel roof for the power house, and the car house were executed by the Berlin Iron Bridge Company, of East Berlin, Conn. The local contractors for the power house building were Messrs. Muir & Fromherz, and for the workshops and general offices, Messrs. Kelly Bros.

The officers of the company are: President, Jos. Hernandez, who with Mr. Chas. A. Black, vice-president, took a very active part in bringing the work to a successful completion, with the aid of the Directory; Walter V. Crouch, secretary and treasurer, and Chris. V. Haile are old and tried officers who have served the company with honor and credit for a number of years.

Mr. W. N. Sheaff, who is well known in electrical circles, has lately accepted the position of superintendent of motive power, and as such, has charge of all the electrical and mechanical equipment of the road.

All the plans and details of these works were designed, and carried out under the directions of A. Langstaff Johnston, member Amer. Soc. C. E., of Richmond, Va., as chief engineer, with Mr. F. P. Chanute, of New Orleans, as assistant.

ELECTRIC ROADS IN CLEVELAND.

THE consolidation of four out of the five electric street railway companies of Cleveland is now all but complete, and a large increase in capitalization is to follow. The suggestion of the deal came more than a year ago, when the Seligmans of New York tried to effect a combination. The managers of the roads felt they could do so without outside assistance and thereby put the profits in their own pockets. The Broadway and Newburg first combined with the East Cleveland a few months ago, and now the Brooklyn and South Side companies, which Congressman Tom L. Johnson and his brother have controlled, have formally decided to enter the consolidation.

The capital of the new company, which is to be called the Cleveland Electric Railway Company, will be $12,000,000, about twice that of the four original companies, and the mileage is about 65 per cent. of all within the city. Congressman Johnson will be President of the Board of Directors of the new company.

ELECTRIC RAILROADING AT BANGKOK, SIAM.

THE Siam papers give glowing accounts of the electric road just started at Bangkok, by the Bangkok Tramway Company. The electric plant supplied by the Short Electric Railway Company, Cleveland, Ohio, arrived on the 16th of November last. The installation covers a distance of a little over three miles. The plant consists of two 80 h. p. single cylinder automatic cut-off engines, built by the McIntosh & Seymour Engine Company, having a 12½-inch cylinder and a 12-inch stroke, working at 284 revolutions per minute. The engines are driven by steam from two horizontal tubular boilers, 16 feet long by 60 inches in diameter, having a working pressure of 80 pounds, and supplied with water feed by a Worthington pump, through a Jones feed-water heater. The furnaces are large and specially adapted for wood fuel. There are two generators giving 100 amperes at 500 volts each capable of being worked singly or in parallel. The electric current is indicated and controlled at a switchboard by instruments of the latest and most approved system.

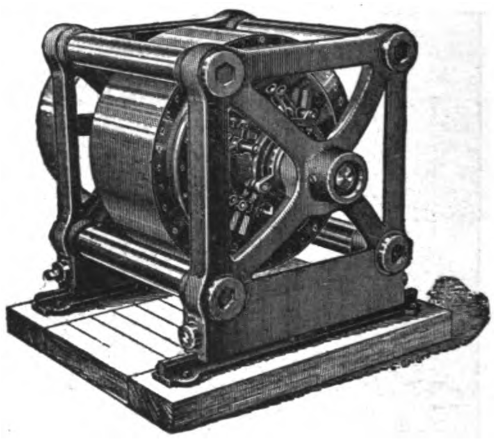
The work has been done by Mr. W. J. Davison, for the Short Company, and the order was given through Mr. E. J. Bagnall, of the firm of Bagnall & Hilles, Brush agents for China and Japan.

THE WADDELL-ENTZ STORAGE CARS IN NEW YORK.

THE employment of overhead trolley wires for electric railways being prohibited in New York and no underground system which would meet all conditions being available, the only means for securing electric traction now open is that by storage cars. The attempts already made in this direction in this city have led to results which may justly be held to be inconclusive and we are glad to note that another trial on a fairly extensive scale is now being undertaken by the Waddell-Entz Electric Company. For some time past this company have been equipping cars of the Second Avenue Railway Company, and they propose to operate the section of the road between 96th street and the Harlem River exclusively by storage cars in order to demonstrate the feasibility of their methods. Through the courtesy of the company, we were afforded an opportunity of attending a trial of the first car sent out on the line, which was in every way successful.

The type of motor adopted has already been described in THE ELECTRICAL ENGINEER but it may be well to recall here that it consists of a Gramme armature with internal pole pieces. At the maximum speed of the car the armature revolves at 500 revolutions per minute and transmits the power to the car axle through a single-reduction gear. The regulation is effected entirely by means of the commutation of the batteries. These are divided into four sets of 36 cells each and are grouped to give the various speeds desired.

One of the notable features of the system and the efficiency of which was beautifully demonstrated during the trial trip was the method of braking employed. Although equipped with the ordinary hand brake the latter was not used, the braking being done entirely electrically. This is effected by short-circuiting the armature while the fields remain fully energized, thus converting the motor into a generator. The powerful retarding action exerted on the armature brings the car to a rapid halt yet with such remarkable smoothness that the suddenness of the stop is hardly felt by the passengers. The cars are equipped with two 20 h. p. motors each, as it is contemplated that they shall haul trailers during the heavy summer traffic.



WADDELL-ENTZ STREET CAR MOTOR.

The cells employed are of the Waddell-Entz copper-iron type with alkaline zinc solution; they weigh about 30 pounds each and the full battery equipment for each car aggregates about 4,000 pounds.

The charging station is equipped for the handling of batteries sufficient to run 10 cars, the number to be operated, and the arrangements are exceedingly well worked out. The charging current is furnished by a 50 k. w. Waddell-Entz multipolar generator direct connected to an Ideal engine, a second similar unit being held in reserve. The batteries are charged on the second floor of the building and are handled entirely by means of an electric traveling crane built by Messrs. Sellers & Co., of Philadelphia, according to the designs of Messrs. Waddell and Entz. This crane is arranged to travel back and forth, to traverse and to raise and lower, being controlled entirely by switches from a single point on the operating floor. The batteries as they are slid out of the cars are raised to the floor above and dropped into their proper places on the charging floor, the entire operation requiring scarcely a minute.

It is expected to have the entire equipment of 10 cars in full operation by June 1.

MESSRS. PEPPER & REGISTER have been awarded a contract for equipping 30 miles of street railway for the Philadelphia Traction Company with overhead construction, poles and bonding. The contracts cover three of their lines as follows: 12th and 16th street line, 13th and 15th street line, and 22d street and Allegheny avenue line.

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GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
Western Editor and Manager, L. W. COLLINS, 575 The Rookery, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. HANKS.
Phila elphia Representative, 501 Girard Building, }

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

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ELECTRIC RAILWAYS AND ELECTROLYSIS.

THE statements made on this page in THE ELECTRICAL ENGINEER of April 12, calling attention to the evil effects of insufficient ground return circuits in electric railways have served to bring out a communication from Mr. Hermann Lemp, of the Thomson Electric Welding Company. In the editorial above referred to we ventured the opinion that the rail itself, independent of ground, would be found all sufficient for the return circuit if the means provided for bonding at the joints were adequate first, to transmit the current without appreciable loss and, secondly, to withstand the deteriorating influence both of the current and the shocks of the passing car wheels. In view of this, the announcement by Mr. Lemp that continuous welding of the rails has proved successful will be read with more than ordinary interest by electric railway managers. Taking into consideration the specific resistance of iron as compared with that of copper, the combined area of cross-section of the rails will generally be found to be less than that of the copper feeders of the system even on roads with the heaviest traffic, while on small roads the disproportion will be largely in favor of the rails. The introduction of the welded continuous rail may therefore be expected to remove largely, if not entirely, the evils complained of. But there is another vista of improvement in electric traction opened by the welding of the rail in the means which it affords for the exclusion of the rail joint from the tracks. It was the failure at the joints due to the increased weight of the electric cars which made it necessary to introduce heavier rails and even this has in many cases not proved successful where the track construction has been carelessly carried out. If we may accept as conclusive the results already obtained with the continuous welded rail given by Mr. Lemp, they foreshadow not only the removal of one of the most serious difficulties encountered in electric traction, but would seem to indicate that a lighter rail than has heretofore been deemed good practice may be found to be serviceable. A successful demonstration of the value of continuous rail welding on street car tracks must of necessity force this system upon the attention of steam railway managers who, from the very beginning of railroading, have been wrestling with the "joint" problem. It must be borne in mind, however, that the conditions of the street railway and the steam railway rail are not absolutely identical. Being in close contact and partially buried in the ground the street rail is not subjected to such great variations in temperature as the steam rail. But the enormous benefits in sight leave little doubt that we shall soon be able to record the trial of the jointless welded rail by some of our more enterprising railroad companies.

THE "COMEDY" AND "COMITY" OF THE COURTS.

WHEN the story of the Goebel incandescent lamp was first unearthed, THE ELECTRICAL ENGINEER was greatly impressed with the fact that it had enough of probability in it to make a strong defence. For that reason, in advance of any of its contemporaries it gave the story all possible prominence and fullness. Judge Colt in Boston told the Beacon Company, however, that the story was "too thin," even suspicious; and injunctions galore were issued forthwith.

The scene is shifted to a Southern Court. Another defendant, still sharing our opinion, again alleges the likelihood of the Goebel story, and reinforces the original defence with a greater cloud of witnesses and additional antediluvian lamps. Judge Hallett brushes aside the curious procedure known as the "comity of the courts," and practically saying that he believes the story, refuses to grant an injunction. Once more, then, the lamp manufacture is open, except for those who were crippled in the first struggle. Is not this grim "comedy" rather than "comity"?

Last week THE ENGINEER was first in the field with the "feeder and main" decision. It had been contended by the complainants that this decision would insure to the General Electric Company control of the use of railway feeders as well as those for lighting. But the decision does not seem to do so, nor did the testimony which we quoted from the complainants' own witness, Dr. Chandler. Is it to be wondered at that weary of the vagaries of the Courts, the companies sometimes prefer combination to fighting?

At any rate, the art is broadly free again, and the best lamps will win. The fight has been both brilliant and dogged. No one will forget Mr. Fish's impassioned appeal in Boston, which carried the day; but Messrs. Witter and Kenyon have the keen satisfaction of knowing that although worsted in the Beacon suit, their skill and pluck in behalf of the Columbia Company have wrested victory to their side.

MR. GEORGE B. MULDAUR, of the editorial staff of THE ELECTRICAL ENGINEER, is now stationed at the World's Fair, as its special correspondent there.

MISCELLANEOUS.

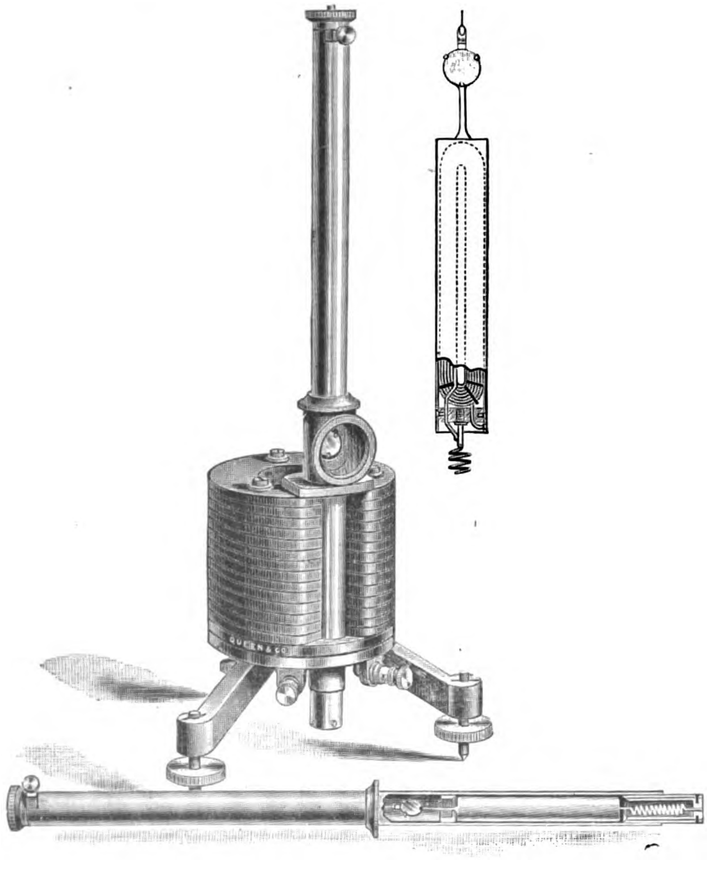
RECENT IMPROVEMENTS IN D'ARSONVAL GALVANOMETERS.—III.

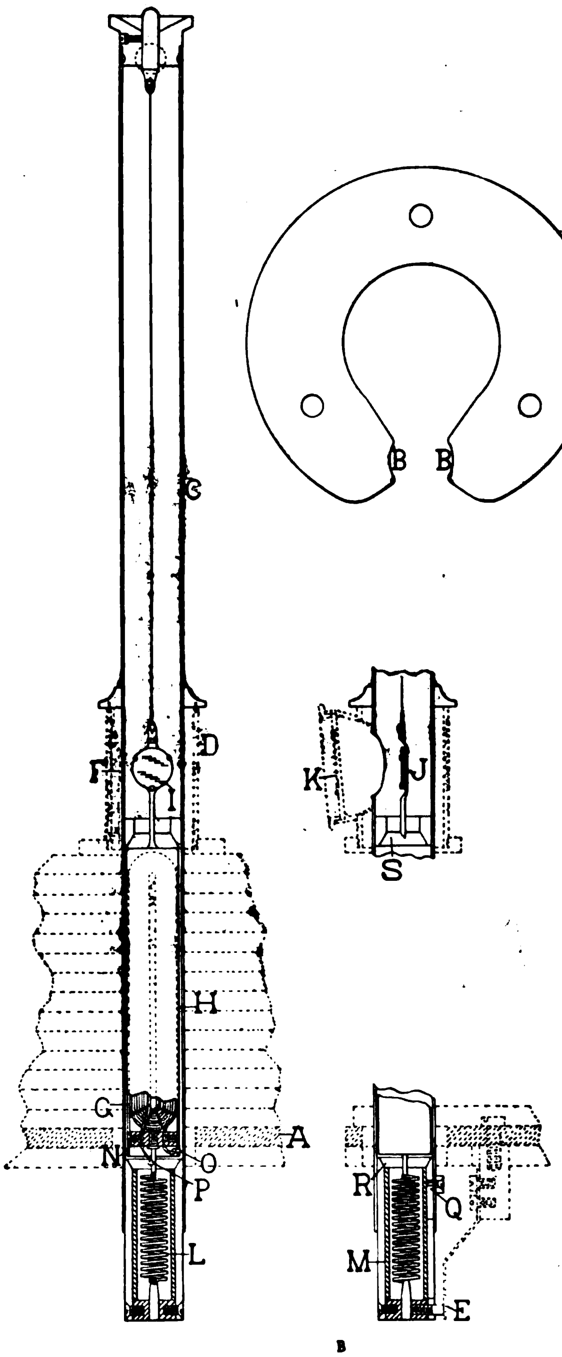
(*Concluded*).

BY NELSON H. GENUNG.

We will now turn our attention to the New Queen-d'Arsonval galvanometer, this being its first appearance outside of their factory and electrical laboratory. Fig 8 shows the assembled instrument. All the parts are of rigid construction, and the instrument, as a whole, while it presents a pleasing appearance, presents a rugged, workshoplike appearance as well.

The magnet, having an outside diameter of four and one-half inches, is built up of a number of discs held together by means of three bolts and is mounted on a sheet of hard rubber, A, Fig. 9, which insulates it completely from the metal tripod base. The pole faces B B are concaved, thus tending towards uniform deflections. At the same time the corners are slightly rounded, so as to avoid too great a leakage around the coil. The suspension tube C, 16 inches long over all, slides freely between the poles, which together with the mirror cage D attached to them, hold it rigidly in position. This tube containing the entire system may be slipped out without the necessity of loosening a single screw and another tube put in place. Connections are made automatically by means of sliding contacts at E and F. The coil G fills the aluminum tube H, to which it is rigidly attached. The space within this tube allotted to the coil is 3⅛ inches long by 9/16 inch in diameter. The coil itself has a cross section represented by two tangential circles, as shown in Fig. 5, this being the most approved shape. To the top of the aluminum tube is attached the mirror I, held in place by a three-armed aluminum clip. The silvered surface of this mirror lies in the axis of rotation as shown at J. thus eliminating one source of error usually overlooked in galvanometer construction. The glass window K of the mirror cage is tilted, as shown, so as to avoid reflection of the scale from its surface into the telescope. The suspensions may be of any desired material. Flattened phosphor-bronze wire is, however, usually employed, a long spiral spring L, forming the lower connection. The portion of the tube surrounding the spiral has a hard rubber lining M, which avoids all possibility of short-circuiting. The terminals of the coil pass through the hard rubber base N, of the aluminum tube, one being soldered at O, to a copper plug riveted into the side of the aluminum tube, and the other at P, to the projection to which the spiral spring is attached. The lower end of this spiral is connected, by means of the platinized spring contact E, to one binding post. The other binding post is reached through the aluminum tube, the upper suspension, the suspension tube, the platinized contact at F, the mirror cage D, and the magnets. The lower end of the suspension tube makes sliding contact with the tube proper, its range of movement being limited by the slot and pin at Q. As a means for clamping the system, the upper edge of this sliding portion is reamed out, as shown in the figure at R, and just above the aluminum tube is fastened a collar S, similarly shaped. When the lower end of the tube is shoved up, the coil is not only clamped but lifted slightly as well, thus entirely relieving the suspension wire of all strain. By this means the coil is held perfectly rigid during transportation without the least fear of injury to any part of the system.





FIGS. 8 AND 9.—THE NEW QUEEN-D'ARSONVAL GALVANOMETER.

By properly slotting the aluminum tube the damping effect has been reduced sufficiently to cause the system to make from four to five complete oscillations before coming to rest.

A coil wound with 703 turns of No. 36 copper wire, resistance 183 ohms, having a phosphor-bronze strip suspension and a spring of platinum-silver wire .0025 inch in diameter gave a sensibility of 80 megohms. With a coil wound with 1,271 turns of No. 40 copper wire, resistance 880 ohms, employing the same suspension and spring as before the sensibility became 166 megohms.

A coil of 694 turns No. 36 copper wire, resistance 178 ohms, was employed with the following results: suspension .0014 platinum-silver wire, spring .0025 platinum-silver wire, sensibility 50 megohms. Suspension phosphor-bronze strip, spring .0025 platinum-silver wire, sensibility 100 megohms. Suspension and spring both of phosphor-bronze strip, sensibility 200 megohms. According to this, a coil of No. 40 wire will, when employing phosphor-bronze strip for both suspension and spring, have a sensibility of at least 325 megohms.

A coil of 1,270 turns of No. 40 copper wire, suspension 8½ inches long, of phosphor-bronze strip rolled from wire, .0015 inch in diameter, has been recently tried. In place of the spring at the bottom, a loop about 18 inches long, of the same material, size and shape as the suspension was used. The figure of merit was 995 megohms.

As a ballistic this arrangement gave the following results, employing in each case one microfarad capacity and one Clark-Carhart cell, E. M. F., 1.44 volt.

	Period.	Throw.
No inertia mass attached :	17 secs.	50.2 cms.
Inertia cylinder attached :	37 "	24.6 "

LETTERS TO THE EDITOR.

LOW RESISTANCE FOR RAILWAY GROUND RETURN.

In your editorial columns of April 12, you invite discussion on the best methods available for obtaining a low resistance ground return for electric railway circuits. You justly find the difficulty not so much in the resistance of the rail itself, but more in the methods used so far for producing a joint between rails, of sufficiently high conductivity and of lasting qualities. I am in position to state that what seems to be an ideal bond has been found and will be seen in a few weeks in practical operation in the city of Boston.

It has been for a long while the dream of the railway engineer to possess a continuous track without joints. The principal difficulty in the way of such an endless track has been twofold. First, the expansion and contraction of the track itself under varying temperatures, and, second, the absence of a suitable process for carrying out the homogeneous uniting of commercial rail lengths. The Johnson Company, of Johnstown, Pa., so noted for their enterprise in manufacturing girder rails, crossings and switches for street railways, have quietly laid an experimental continuous track in Johnstown of about 1,000 feet in length and have tested the same daily for a period covering more than a year, noting differences in temperature and corresponding expansion. An allusion to this experiment may be found in THE ELECTRICAL ENGINEER reporting a paper of the president of the Johnson Company, Mr. Moxham, read at the Buffalo Street Railway convention. The conclusions from this experiment were: that as far as a street railway track was concerned, the expansion of the rail is only nominal, about ⅛ of an inch in 1,000 feet and can be neglected. There are two explanations for this result which is apparently inconsistent with accepted opinions, and they are:—

The rail used for street railway is, unlike its first cousin, the steam-road rail, almost completely buried in the ground. It is not likely, therefore, to have its temperature vary any more than the ground itself. A second factor is the increased resistance of the roadbed itself, opposing the movement of the rail. The rail is held in a vise, as it were, resisting any motion of the rail in a line parallel with its axis, and expansion has to take place in a direction in which there is no check upon it; in other words, the rail is growing thicker and thinner during temperature changes and within the elastic limit of the steel. Whichever of the two factors is the more prominent, one thing is certain that the experiment carried out under normal working conditions has shown that the expansion need not be considered.

The second obstacle, the want of a process to carry out commercially and economically, the uniting of the rail sections has been removed by the advent of Prof. Thomson's electric welding process. The Johnson Company, who, for years have been constant users of this process, have placed last summer an order with the Thomson Electric Welding Company for the necessary apparatus to weld rails by electricity. On Feb. 1st, 1893, the first trial of the apparatus was made at the works of the Thomson Electric Welding Company, at Lynn, where three rails were welded by taking and transforming the necessary energy from the trolley line of the Lynn & Boston Railroad Company. The station furnishing the power was about a mile distant from the place where the trial was made. It will be interesting to state that the welds when made on an 8½-inch Johnson girder rail had an actual cross-section of 25 square inches of weld, and required approximately 200 h. p. This represents of course the most severe conditions, and the ordinary rails will not require more than 100 h. p. for a weld. The time of welding varies from four to sixteen minutes according to the size of weld to be made. Early this month the electric welding car of the Johnson Company has been given the first trial in Johnstown in welding sections of rails in different parts of the city, for the purpose of allowing the operator to become thoroughly acquainted with the practical operation of the plant, and in a few weeks the car will be seen in the streets of Boston at work. It is safe to say that this method of uniting rails will be given a thorough trial, and if successful, will go on record as a step in a progress of which the electrical as well as the railroad engineer may well be proud. A full description of the electric welding car cannot be given at present for various reasons.

HERMANN LEMP,
Electrician of Thomson Electric Welding Company.

LYNN, MASS., April 15, 1893.

MR. STOWELL'S REMINISCENCES.

IN THE ELECTRICAL ENGINEER of April 12, appears a letter from Mr. Wm. J. Hammer in reply to my letter of March 29.

I am exceeding sorry if any word of mine in that letter should have led to any misconception.

The public who read such articles can hardly realize the great amount of labor, care, and painstaking required to collect such valuable facts as Mr. Hammer has put into these articles. I never would have written a word if I had imagined it would have started any controversy.

I have always claimed that I had charge of and exhibited the first electric light from a dynamo in this country at any fair. The following article published in the *Electrical Review* has never before been questioned. I am sorry I am away from home and therefore cannot consult my note books,—not that I have the least desire to continue writing, or say a word that would in the least wound the feelings of Mr. Wm. J. Hammer, whom I am proud to have as a friend, or take one iota from the well-earned fame of Mr. Wm. Wallace who always treated me with kindness, and of whom I have none but pleasant memories. I have always claimed for Mr. Wallace the honor to be the first to run arc lights in series. It was first done at Ansonia, Conn., while I was in Philadelphia at the Centennial, and it was shown me during a hasty visit home.

While wiring the building in Boston in 1878, some of the Brush people looked on and said aloud : "He can never run lamps that way."

A Short History of One of Prof. Moses G. Farmer's Dynamo Electric Machines.

To the Editor of Electrical Review :

THE machine was built in the latter part of the year 1873, and experimented with at No. 15 Congress street, Boston. About 175 pounds of No. 16 copper wire were used on the field coils and armature, the whole machine weighing 900 pounds. There was no steam-power in the building, and so a large cast-iron wheel, with belt to machine, turned by two men, was used. The arc light was with carbons, adjusted by hand.

It being a great curiosity, many came in to see it, and among them Mr. Frost, chief engineer of the Hoosac Tunnel. He was so well pleased that he wanted to have the whole thing sent up there to try the light at the heading. Mr. Frost said he had men enough to turn it. Mr. Farmer sent his assistant up to the tunnel to see if there was any way to utilize the compressed air that they were using in driving the Burleigh drills. He went and reported favorably. An electric lamp was made and the machine and lamp were taken to Mr. Thomas Leavitt's machine shop, where it was run successfully by steam. It was never taken to the tunnel for this strange reason, that there were not enough carbons in Boston to supply this one lamp a single month. All carbons were imported then.

The machine and lamp was exhibited at the Mechanics' Fair, in Quincy Hall, in the fall of 1874, together with two torpedo machines, and a silver medal was awarded Mr. Farmer. A reflector was used with the lamp, and the light was so intense that shadows of the gas flames were cast, the gas jets being more than 150 feet from the electric light.

This is believed to be the first electric arc lamp exhibited in this country, where the electricity used was generated by a dynamo machine. In the year 1852, at New York at the Crystal Palace, an electric light was exhibited, but the current was from a magneto machine.

As soon as the fair closed, the machine was taken to the Inst. Technology, and a series of experiments made with it by the professors.

It remained there until June, 1875, when Mr. Charles Stowell took it to Philadelphia to the Centennial grounds, near to the then unfinished Art Gallery. This was done at the suggestion of Prof. Geo. F. Barker, who had charge of the experiments, and who also had his own Gramme machine mounted upon a wagon (with portable engine to drive it), drawn to George's Hill. The Farmer machine furnished a light on the dome of the Art Gallery. Both lights were used on the evening of the 5th of July, 1875 (the 4th fell on the Sabbath).

The committee of the Centennial Exhibition were present, and desired to try it still farther, so the lights were lit again on the 6th. This time the Farmer machine lit the lamp on the top of a hastily constructed wooden tower, near the main entrance to the grounds, and Prof. Barker's was used all over the grounds, being drawn from place to place, as the committee desired.

The Farmer machine is still in existence, but has not been used. A few years ago it was proposed to place it among other electrical devices in the Franklin Institute.

CHARLES STOWELL.

P. S.—I would much like to know if any of the readers of the *Review* know of any earlier dynamo-machine. Mr. Farmer told me he was pretty sure it was the first.

C. S.

Mr. Paul, president of the Massachusetts C. M. Association, and Mr. Charles Slack visited Mr. Wallace's works, and I hung three lamps, one in each story of the factory; all three were in series and run from one machine.

They expressed great delight, and on their return, a vote was passed by the society inviting Mr. Wallace to make an exhibit at the Fair.

I have a copy of that vote at Boston, from the secretary, Mr. Bates.

New York City. CHARLES STOWELL.

PAPER INSULATED WIRE AND ITS MANUFACTURE.

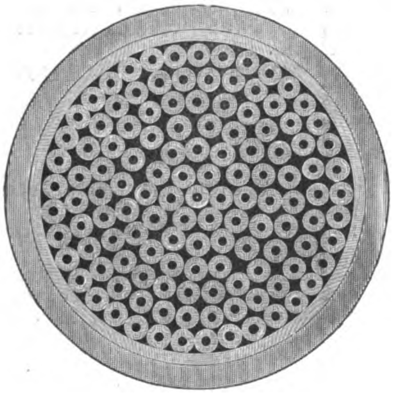


Fig. 1.—Norwich Telephone Cable.

A FEW years ago the idea of the use of paper for purposes where high insulation of wires was required would have been generally ridiculed. To-day, the experience of the electrical community has been such that the insulation about which incredulity more vigorous than polite was expressed, has come to enjoy the highest reputation. Part of this change of feeling is due, no doubt, to the intrinsic merits of the method broadly; a large part certainly to the improved processes adopted in the preparation of paper insulated wires and cables for the market. It must be obvious that certain qualities are to be aimed at in each of the different fields of work. At first these may not have been clearly understood, though even from the outset paper demonstrated its ability to insulate in a manner that was simply marvelous. At the present time, paper insulated wire and cable has no longer to ask for a hearing. Its merit is familiar and it has become merely a question of meeting all the wants of a field that never ceases to develop new requirements.

We are glad to have the opportunity to lay before the readers of THE ELECTRICAL ENGINEER a few details of the manner in which paper wires and cables are made by the Norwich Insulated Wire Company, of this city, the pioneers in this new art and the owners of the fundamental McCracken patents on the subject. The researches of Mr. E. McCracken in this branch date back many years, and it would appear that he was the first to discern the vital value of insulation composed of spirally wound and overlapping strips of pure vegetable fibre paper. His patents cover not only the idea but a great many ingenious ways of applying the insulation swiftly, cheaply, and efficiently. Be this as it may, there can be no question that from his work a new period dates, and that the Norwich Company with his aid has been able to accomplish results that few expected or imagined possible.

As a matter of fact the company at its fine factory in Harrison, N. J., which we here illustrate, Fig. 2, has reduced the processes of manufacture down to a striking simplicity. The factory is a solid brick building, 120 by 225 feet, with boiler and engine room and power capacity up to 200 h. p. It has its own electric light plant, dynamos for testing, a gas plant, and a full equipment of machinery of the latest and best description, enabling it to insulate and cover any conductor from No. 20 B. & S. up to a cable of 2,000,000 circular mils. Its telephone cables run up to as many as 104 pairs of metallic circuit conductors, Fig. 1—208 wires in the single cable! Of course care is essential, but the miles of wire and cable now turned out every week test up with remarkable evenness and perfection. The paper which is used is specially made and is thoroughly "cured" or seasoned, improving like wine, with age. The rolls come from the mills in varying lengths from less than a mile up to five miles; and then are mounted as shown in Fig. 3 for cutting into strip by circular shears, which leave the paper resembling "ticker" tape. These tape rolls or spools are placed on mandrels in the covering machines in the department shown in Fig. 4, and as the wire feeds through, the paper is laid on in overlapping spirals at the rate of from 60 to 500 revolutions of the mechanism per minute. The spirals run alternately in opposite directions, and in addition to that, the papered wire runs through snug dies which render the insulation very tight and compact. When the wire is covered with paper to the required degree, it is wound on iron reels which are placed in drying ovens that have a temperature of 250° F. This naturally expels all moisture, and then while still under the effect of this high temperature the wire is plunged in a special, secret compound for some time, and literally stewed there, the temperature being maintained at about 275° F., by means of steam coils.

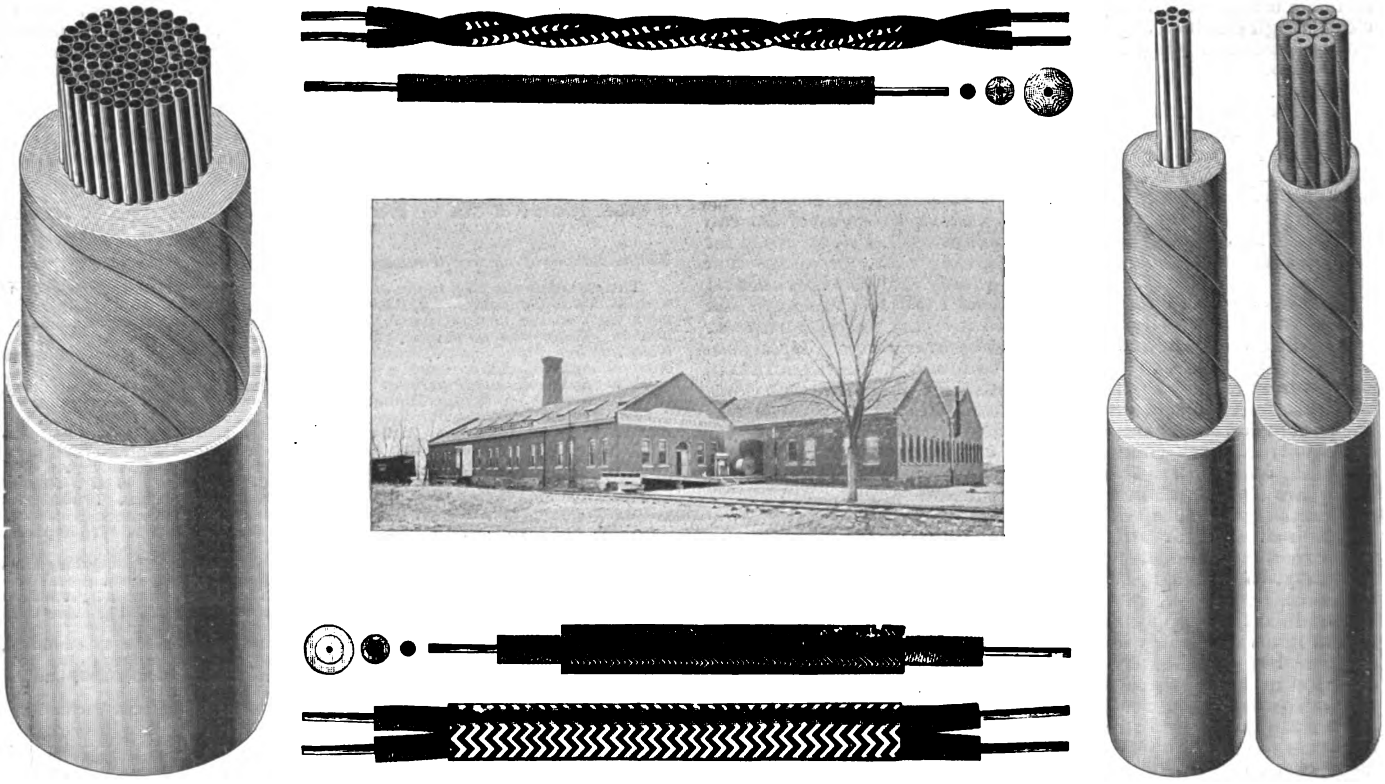
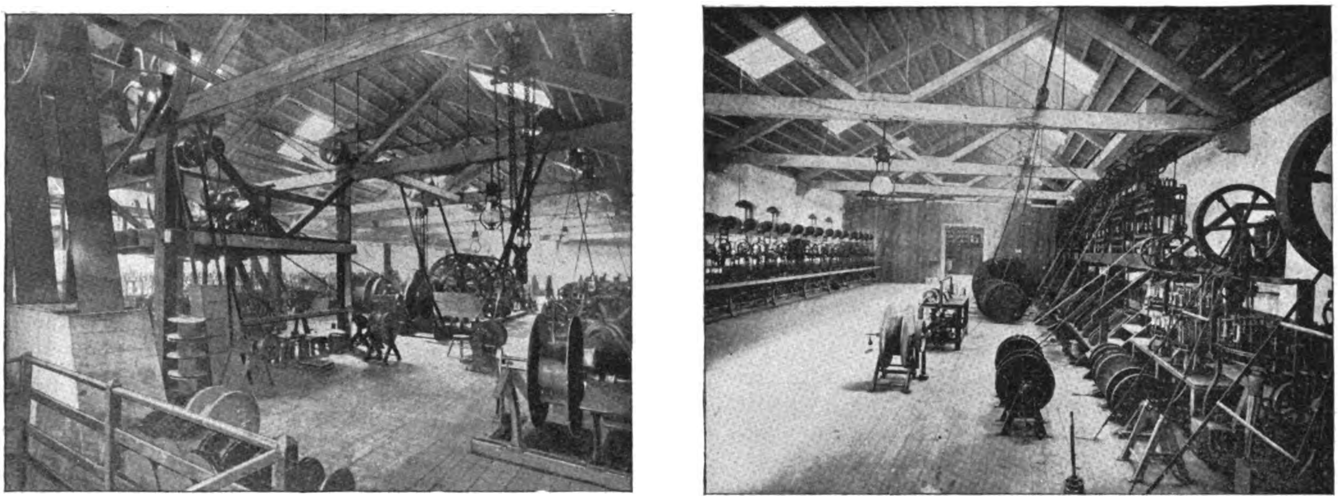


FIG. 2.—THE NORWICH INSULATED WIRE CO.'S FACTORY, HARRISON, N. J., AND SOME OF ITS PRODUCTS.

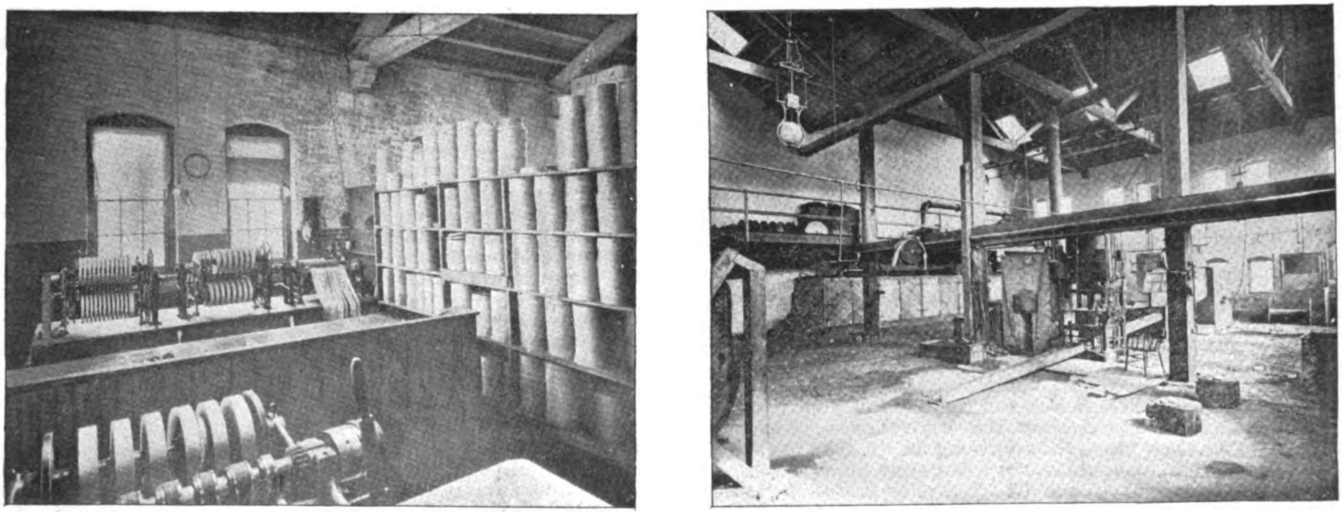
At this stage, the paper insulation processes cease. The wires and cables in their paper skin or jacket have a peculiar look—very much as though rawhide had been melted and poured all over them, or as though they had been dressed in some peculiar gelatinous gum which had hardened hermetically all around them. But the wires now go from the tanks to the braiding department, part of which is shown in Fig. 5, or the leading department, Fig. 6, where by some very ingenious machinery the lead is laid on continuously.

Fig. 2 shows the wires and cables at various stages and also complete ready for use. It is noteworthy that the conductor throughout its treatment remains perfectly concentric, and that the insulation "stays where put."

It has been, the writer believes, a popular notion that paper cable was chiefly intended for telephone use. Its success in this field might warrant the idea, but, in reality, paper has been found to be the very thing for the high potential currents, up to 10,000 volts and more, that are the fashion of these later times. In ordinary high tension lighting a very encouraging record has been made. In Chicago, the Central Electric Light and Power Company has some 10 miles of it, and Mr. C. H. Wilmerding of the Chicago Arc Light and Power Company, who has been using it for two or three years, is increasing his mileage. Last October he had already laid down nearly 70 miles of it. Some of this was for 1,000 volt alternating, some for 500 volt direct, for power work, and the remainder for 2,000 to 3,000 volts on arc circuits. Mr. Wilmerding considers that one of the reasons of the immunity from break-down and burn-out is the fact that it is less difficult to make a good joint with paper cables than with others. Paper cables have also been employed on similar heavy work in lighting in Washington, D. C., Ft. Wayne, Ind., Boston and New York city. Frequent instances show that the paper insulation is affected neither by extreme heat nor by extreme cold. The writer has seen some samples that illustrate forcibly how difficult, if not impossible, it is to set on fire closely packed paper. One piece of cable from the big Siegel-Cooper fire in Chicago is a marvelous example of resistance to heat and flame, and suggests that our fire-proof buildings may some day be made of pillars and beams of spirally-wound paper.



Figs. 4 and 5.—Covering and Braiding Departments, Norwich Insulated Wire Co.



Figs. 3 and 6.—Paper Cutting and Leading Departments, Norwich Insulated Wire Co.

The writer has been favored with a number of tests of outgoing wires and cables, at the Harrison factory, made by Mr. T. J. Clarke, the electrician, The telephone cables of 51 pairs of Nos. 17 and 19 wire, B. & S., show an average capacity of .078 microfarad, .0700, and around those figures. Electric light cables of 500,000 circular mils run up to 4,961 megohms insulation per mile; and No. 6 B. & S. shows 8,050 megohms.

The factory is very busy, so busy indeed that with a growing demand it experiences difficulty in keeping pace with orders. The company's management has lately been placed in the hands of Mr. George J. Jackson as general agent, and the other officers of the company are, Chas. Neumann, President; W. J. Fanning, Vice-President; C. Backe, Secretary.

"KODAK" PLANTS IN ELECTRIC RAILWAY WORK.

The Brooklyn City and Newtown railroad has placed orders for two more "Kodaks," which has come to be the popular name for direct-coupled generators. The units employed in this station are a 250 h. p. generator coupled direct to an 18-30 x 16 Westinghouse compound engine at 250 revolutions. The power station of this road will contain eight of these generators, of which five are already in place. A single one of these Kodaks has handled thirty-eight cars over the considerable grades of this road continuously.

The contract for the new power house of the Newton and Boston street railway, at Newtonville, Mass., has been awarded to Westinghouse, Church, Kerr & Co. The steam pressure will be 130 pounds, using Babcock & Wilcox boilers. The generator room will contain two Westinghouse compound engines, condensing, driving Thomson-Houston multipolar generators. The original installation is for 400 h. p., and the station is to be in operation July 1.

PERSONAL.

THE ELECTRICAL AND MECHANICAL ENGINEERING AND TRADING COMPANY.

The above company has been incorporated recently, and is now located in the Edison Building, Broad street, New York city.

In the selection of Mr. J. H. Vail as president and chief-engineer of the Company, the new concern has secured a man of more than usual executive ability, and also of unequaled experience as an electrical and mechanical engineer. Mr. Vail was born in Middlesex County, New Jersey. After finishing his education, his natural inclination for mechanics led him to enter the Empire Machine Works, at New Brunswick, N. J., where he spent nearly seven years. Rising rapidly in his chosen profession, he was appointed superintendent of the works after two years' service, and soon became manager, which position he held until he entered another field.

An experience of over two years in the office of the Assistant-Quartermaster-General, U. S. A., New York city, largely assisted in developing and perfecting his natural executive capacity. A further pleasant and profitable experience was gained with the Kansas City, Fort Scott and Gulf Railroad Company, at the Kansas City shops, where he prepared plans and specifications for many kinds of passenger and freight cars, as well as some locomotive work.

J. H. Vail, M. E., E. E.

In the summer of 1880, Mr. Vail entered the employ of Mr. T. A. Edison at Menlo Park, N. J. During the fall and winter of 1880 and 1881 he was in charge of the original exhibition central station plant at that place, thus deriving an experience that can never be forgotten, and which not a few envy him. He erected the original exhibition plant at 65 5th avenue in February, 1881, and installed many of the early isolated plants of the Edison Company. He was appointed superintendent, in December, 1881, and later, the chief engineer of the Edison Company for Isolated Lighting. Under his charge the work of the Edison Company received a constant, attentive and absorbing personal care that did much to secure for it the prominent position it enjoys. Mr. Vail formulated rules and specifications and many plans that at this day are recognized standards of practice. His rigid personal inspection, his uncompromising disapproval of bad and shiftless work, and his hearty praise of the most perfect work, have resulted in decided advances. The incandescent electric light became a great success. A great number of large installations in marine work, hotels, theatres, public institutions, mills and factories that were each prominent and possessed special features of merit, were designed and carried out under Mr. Vail's direction.

George F. Sandt, M. E., E. E.

In 1885, the Edison central station business was taken over by the Edison Isolated Company, and Mr. Vail became chief engineer of central station construction. Nearly 200 central stations have been constructed under his supervision. A high grade of skilled work, combined with permanency of construction and economy in first cost, as well as in operation, and convenient and compact arrangement of plant and apparatus, have been the leading features of a brilliant success. The following Edison central stations are a few of the many designed by Mr. Vail:

Twenty-sixth street and Thirty-ninth street, New York City; First and Second District Stations, Boston; Adams street Station, Chicago; Easton, Pa.; Toronto, Canada; Detroit, Mich.; Rochester, N. Y.; New Orleans, La.; Minneapolis, Minn.; Kansas City, Mo., and many others, all of which are successful as well as profitable investments for the stockholders. He has also designed and constructed many electric railway power stations and numerous combination stations for railway, incandescent and arc lighting.

Mr. Vail is thoroughly familiar with all kinds of underground and overhead distributing systems. He is a constant student of electrical and engineering progress, and keeps fully up with all advances. He is a member of both the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.

He possesses in an unusual degree the valuable faculty of analyzing the merits of new devices, apparatus or systems, and the ability to unite in a station or system such combinations of boilers, engines, dynamos and appurtenances as will best meet local conditions and show good results in economy and net earnings. The results of his engineering work prove that his judgment is sound and unbiased.

Mr. George F. Sandt, the secretary and treasurer of the Company, was born at Easton, Pennsylvania. After graduation at Lafayette College, Easton, Pa., in 1882, with degree of A. M., and at Stevens Institute of Technology, at Hoboken, N. J., in 1884, with degree of M. E., he entered the engineering department of the Edison Company. Since that time as a member of the engineering department he has been closely allied with all of its work, which has well fitted him for his future duties in the new concern. Prominent among the many works of which he had special charge were the following:—The arrangement of the system of distribution and the calculation of the sizes of the electrical conductors for the Edison three-wire system at Boston, Mass.; Cincinnati, Ohio; Columbus, Ohio; Detroit, Mich.; Easton, Pa.; Reading, Pa.; Rochester, N. Y.; Milwaukee, Wis.; Topeka, Kan.; Winnipeg, Man., and for a large number of other installations.

U. T. Fackenthall.

He also has been prominent in the preparation of the plans of many of the above stations. During the building of the subways in the upper part of New York City, in 1889, he had charge of the installation of the Edison underground system.

For the past three years he has ably filled the position of chief electrical assistant to the engineer-in-chief of the General Electric

Company, during which time he has designed the arrangement of systems of electric distribution, designs of electric apparatus and switchboard of many of the recent stations such as Easton, Pa.; Rochester, N. Y.; Milwaukee, Wis.; Cincinnati, Ohio; San Francisco, Cal.; illustrations of which have frequently appeared in the technical papers.

Mr. U. T. Fackenthall, the vice-president and general manager of the Company, is an example of the large class of Americans, known as self-educated and self-made, and equal to all the duties and responsibilities of each new elevation. His experience in the machinery and exporting business extends over many years, during which time he has gained a wide acquaintance among the allied trades, which will doubtless be turned to good account in his new business relations in the electrical field. Mr. Fackenthall is a gentleman of excellent business and executive ability, full of push, perseverance and enterprise, and this, coupled with his genial qualities, and indomitable energy, justly fits and qualifies him for the office.

DEFINING THE CANDLE POWER OF ARC LAMPS.

In a letter addressed to Prof. Elisha Gray, chairman of the committee on Electrical Congress, of the World's Columbian Exposition, the representatives of various electric lighting interests in Chicago call attention to the confusion which still exists caused by designating arc lamps as of 2,000 c. p., 1,200 c. p., etc. Referring to a paper read by Prof. Elihu Thomson before the National Electric Light Association, in Providence, R. I., in February, 1891, and the difficulty experienced by purchasers of apparatus in measuring the candle-power of arc lamps, the following is proposed for discussion and adoption by the forthcoming congress.

"The term 2,000 c. p. is to mean an arc produced by 10 amperes and 45 volts potential difference between the carbons, or a 450-watt arc. The candle-power of arcs produced by currents of more, or less, amperes, or more, or fewer, volts difference of potential, to be rated proportionally."

Such a definition, it is believed, would at once call a halt to all disputes on this question and would enable every station superintendent, by simply employing a standard amperemeter and a standard voltmeter, to determine whether or not the electric contractor has fulfilled the conditions of his contract as to candle-power or not.

The letter is signed by the following: Brush Electric Co., S. A. Douglas, Dist. Mgr.; South Side Electric Co., W. H. Harding, Mgr.; Western Electric Co., C. D. Crandall, Mgr.; Great Western Manufacturing Co., A. K. Gilman, Bus. Mgr.; Standard Electric Co., D. P. Perry, Mgr.; General Electric Co., B. E. Sunny, Western Mgr.; Chicago Arc Light & Power Co., C. H. Wilmerding, Pres.; City of Chicago, Electrical Dept., Jno. P. Barrett, Supt.; The Chicago Edison Co., Samuel Insull, Pres.

THE RIGHT TO COLLECT CITY FEES FOR POLES.

By deciding that the city of St. Louis has a right to collect $5 a year rent for every telegraph pole set up in her streets the United States Supreme Court has settled an important matter. It is that any city government has entire right to say what its streets shall be used for by private companies and also what money they shall pay for such use. The Western Union Co. is now fighting this decision.

REPORTS OF COMPANIES.

THE GENERAL ELECTRIC COMPANY'S REPORT.

A valued correspondent, signing himself "Accountant," sends us the following suggestive and critical analysis of the General Electric balance sheet:—

I beg to congratulate The Electrical Engineer on its alertness in giving its readers the full text of the first annual report of the General Electric Company on the morning after the stockholders' meeting; and I would at the same time express my appreciation of the justice and moderation of the editorial comment on the report in your issue of April 19. Supplementing your exhibit of the enormous increase of capital liabilities—stock and bonds—incident to and following the combination, and your computation of the earnings as substantially no more than those of the Edison and Thomson-Houston companies together for their last previous corporate years, I submit a reconstruction of the balance-sheet of the General Company which seems to me to set forth the assets and liabilities more lucidly and intelligibly than the report does. It will be noted that the totals are increased by $3,407,578 24. This is occasioned by leaving out of the assets "stocks of underlying companies" and substituting the various assets of those companies (Edison General, Thomson-Houston and International) and the amount representing patents, license contracts, etc.; and by including in the liabilities the debts of those companies. Here is the suggested balance-sheet:—

ASSETS.

Plant, Edison General Electric Company	$2,959,695.85	
" Thomson-Houston Electric Company	1,240,066.77	
		$4,199,762.62
Real Estate, less mortgage		298,726.74
Inventories, General Electric Company (stock of machinery, apparatus and supplies in offices and storehouses of the company's seven districts and outfits of district repair shops)	4,234,485.37	
" Edison General Elect. Company. Schenectady and Harrison	2,576,887.14	
" Thomson-Houston Elect. Company. Lynn	2,407,270.24	
" International T.-H. Company	89,049.98	
		$9,307,692.73
Stocks, United Electric Securities Company	$1,234,370.00	
" Brush, Ft. Wayne, Schuyler and other companies, held through Thomson-Houston Company	2,500,000.00	
" International Co.'s holding of other companies' stocks	13,139.00	
" Manufacturing and other companies	1,580,216.00	
" Local companies	5,772,622.80	
		$11,100,347.80
Bonds of local companies		3,400,629.07
Bills Receivable, General Electric Company	$5,151,950.64	
Accounts Receivable, General Electric Company	7,078,879.15	
Bills and Accounts Receivable:		
Thomson-Houston Company	428,126.91	
Edison General Company	409,117.86	
International Company	937,020.71	
		$14,005,095.27
Cash		3,871,033.58
Patents, License contracts, etc.		8,159,264.02
		$54,342,551.83

LIABILITIES.

Capital Stock	$34,663,800.00	
Bonds, 5 per cent. Debentures Gold	10,000,000.00	
		$44,663,800.00
Notes and Accounts Payable:		
General Elect. Company	$4,554,347.68	
Edison General Elect. Company	1,551,660.71	
Thomson-Houston Electric Company	1,547,964.21	
International T.-H. Co.	307,953.32	
	$7,961,925.92	
Other liabilities	691,871.32	
		$8,653,797.24
Surplus		1,024,954.59
		$54,342,551.83

The above collation and arrangement bring into view at a glance, in groups and totals, the several classes of assets and liabilities of the General Company and of both the Edison and Thomson-Houston Companies, so far as they can be derived from the published report of the General Company. It should be noted that there is a contingent liability of $3,787,312.69 for customers' notes that have been endorsed and discounted by the company as stated in the text of the report, and a further similar liability, amount not stated, for items of the same class of the underlying companies. It is to be regretted that no statements of the amount of business done, aggregate sales, etc., or of gross profits and operating expenses were furnished in the report.

LEGAL NOTES.

JUDGE HALLETT'S DECISION REFUSING AN INJUNCTION UNDER THE EDISON LAMP PATENT.

THE arguments in the suit of the Edison Electric Light Co. against the Columbia Incandescent Lamp Co., of St. Louis, were concluded before Judge Hallett on April 11, and Friday, April 21, he handed down an opinion denying a preliminary injunction and vacating the restraining order previously issued. The opinion, which we print in full below, puts the Columbia Incandescent Lamp Co. under bonds of $20,000, to abide the issue of a final hearing. This bond was filed last Friday, and the factory was started up on the same day.

OPINION OF THE COURT, APRIL 21, 1893.

In the Circuit Court of the United States
for the Eastern Division of the Eastern
Judicial District of Missouri.

EDISON ELECTRIC LIGHT CO. *et al*
vs.
COLUMBIA INCANDESCENT LAMP COMPANY *et al.*
No. 3707.

HALLETT, District Judge.

Complainants allege infringement of Letters Patent No. 223,898, issued to Thomas A. Edison January 27, 1880, for an Improved Electric Lamp. This patent came under the consideration of the Circuit Court of the Southern District of New York, in the case of Edison Electric Light Company *vs.* U. S. Electric Lighting Company (47 Fed. Rep. 454) and was held to be for a lamp "consisting essentially of a filamentary carbon burner, hermetically sealed in a glass vacuum chamber." So understood it is the incandescent lamp in common use, and no question is presented in this record as to the character of respondents' manufacture. The defense to the bill and to the motion for preliminary injunction now under consideration is want of novelty in the Edison patent. Respondents aver that an incandescent lamp, different in form, but in all essential features the same as that now in general use was made as early as 1854 by Henry Goebel, of New York City, and that it was used by him in various ways and at different times for many years thereafter. It will not be necessary to describe this lamp at length as it has the same constituents as the Edison lamp. We are at present more concerned with the struggle between the contending forces, on the one side to maintain, and on the other to disprove, the existence and use of the lamp anterior to the date of the Edison invention. A large mass of testimony in the form of affidavits is offered by each party on the question of fact, which, to consider at length, would be a tiresome and unprofitable task.

The principal objection urged by complainants against the Goebel invention is that it has an impossible date; no man *could* make it in the time and manner assigned to it; the incandescent lamp is the product of several auxiliary arts not likely to fall within the compass of a single mind; as an achievement of science the lamp is a matter of progressive steps, some of which must be made by the world at large, before others can be taken by any one. This is no more than to say that no man can outrun his competitors to any great length, in the field of scientific investigation—a proposition which has no support in reason or experience. There seems to be no reason for saying that Goebel could not reach in 1854, the point attained by Edison in 1879, unless as was said by the dissenting Justices in the Telephone cases: "It is regarded as incredible that so great a discovery should have been made by the plain mechanic, and not by an eminent scientist and inventor."

In so far, however, as it may be shown that the methods adopted by Goebel were not equal to the results obtained, the evidence should receive the most careful consideration. On this point it appears that Goebel has recently made several lamps of the form and with the material and tools formerly used by him. These lamps were tested by men of skill and experience in such matters and they were found to be reasonably effective. They are not so good as the lamps in common use, but they can be operated and they give reasonable service in time and capacity of light. So that in this way we have *prima facie* proof of Goebel's ability to make lamps in the way he claims to have made them before the time of Edison's invention.

It is said that Goebel is involved in contradictions and misstatements of fact due to the lapsing memory of old age or to untruthfulness. Be it so; he does not appear to be an adventurer or an impostor. It is not reasonable to believe that he made the story related in his affidavit and did not make the lamp he has described. Whatever may be said as to Goebel's veracity he is supported at many points by witnesses of good repute who speak with precision and apparently with deliberation. As already suggested it is not necessary or profitable to go over the testimony at length with a view to determine the relative value and weight of every part. It is enough to say that there is a fair preponderance of testimony in support of the Goebel claim.

There is not the measure of proof demanded by complainants' counsel who maintain that the Court should require proof of the fact beyond reasonable doubt. This degree of certainty is not often attained upon testimony in the form of affidavits where the issue is contested. And it is not reasonable to demand such certainty as to the defense. Complainants must show a clear right in support of a preliminary writ, and a defense which puts the case in doubt is sufficient to defeat the application. *Goodyear Co.* v. *Dunbar*, 1 Fisher, 472; *Glaenzer et al.* v. *Wiederer et al.*, 33 Fed. Rep. 583; *Fraim* v. *Sharon Valley Malleable & Gray Iron Co.*, 27 Fed. Rep. 457; *Cary* v. *Domestic Spring Bed Co.*, 26 Fed. Rep. 38; *Robinson on Patents, Sec.* 1171.

It is also contended that the decree of the Circuit Court of New York against the United States Electric Lighting Company sustaining the patent, which decree has been affirmed in the Court of Appeals of the Second Circuit is conclusive of complainants' right to the writ for which they now ask. No doubt is entertained as to the conclusive effect of that decree here and elsewhere as to all matters in issue in that cause. For although respondent was not a party to that litigation the Court would not on a preliminary motion consider any matter which passed to judgment in that suit. But the Goebel defense was not made in that suit and therefore the case has not the authority on this motion which has been ascribed to it. *National Hat Pouncing Machine Co.* v. *Heddens et al.*, 29 Fed. Rep. 147. *Lockwood* v. *Faber*, 27 Feb. Rep. 63. *The Bailey Wringing Machine Co.* v. *F. F. Adams et al.*, 3d B. & A. 96.

Another suit by the complainants against the Beacon Vacuum Pump & Electrical Company in the Circuit Court for the District of Massachusetts is in a different attitude In that suit the Goebel defense was made and upon motion for preliminary injunction recently heard and allowed, it was overruled. It is contended that the ruling in that case should be recognized and followed as a precedent in respect to the present motion. And perhaps, if the issue, the testimony and the situation of the parties appeared to be the same in both cases, such result might follow; more from the persuasive effect of the opinion of another court on the same matter than from any notion of authority ascribed to such opinion. In courts of equal jurisdiction proceeding concurrently in the investigation of the same subject the right and duty of each to exercise independent judgment cannot be denied. That they should in the end reach the same result is greatly to be desired, but one cannot become an echo to the other for that praiseworthy purpose. In this instance the consequences to flow from diverse opinions are not regarded as serious. In the Massachusetts Circuit, and here as well, the motion is interlocutory; and in each case the ruling may well enough stand upon the situation of the parties. And we have much additional testimony to that upon which the court acted in the Beacon case; so that upon all points I do not feel compelled to accept the opinion of the court in that case.

The ruling of the court however in the Beacon case suggests the propriety of taking security from respondent for observing the decree in case complainants shall ultimately prevail in this suit. There are other considerations also which should have weight in that direction. It was suggested by complainants' counsel that respondent is a concern of small capital; and that it was made so with intent to avoid responsibility in respect to the infringement now alleged against it. This was not denied, and I suppose we may take it to be true. The retort was in the form of a charge against complainant that it used its monopoly of electric lamps to control the sale of all kinds of electric machinery and apparatus. This charge also passed without denial, and it is not difficult to conceive of circumstances in which it would be necessary to ascertain whether it is true. Referring only to the charge against respondent of insufficient capital and assets the duty of the court is plain to provide for the contingency of a decision against it. I need not refer to the possible effect of cross-examination in the case of a multitude of witnesses. What now seems plain enough may altogether disappear and new facts may come to the surface under that crucial test.

The injunction will therefore be refused if the respondents shall give a bond in the sum of $20,000 conditioned for the payment of such sum (if any) as may be decreed in favor of complainants on the final hearing of this cause. The bond to be filed with the Clerk of the Court and to be approved by the Clerk or by a Judge of the Court within 20 days from this day.

Henry Hitchcock, Solicitor for Complainants. F. P. Fish, C. A. Seward & R. N. Dyer, of Counsel for Complainants.

Boyle & Adams, and Fowler & Fowler, Solicitors for Defendants. Witter & Kenyon, of Counsel for Defendants.

THE DEATH OF MR. LOWREY.

THE sudden death of Mr. Grosvenor P. Lowrey at his residence in this city, last Friday, caused universal sorrow and regret.

Fitting notice was taken of it in the Courts by both bench and bar. A full biographical sketch is given elsewhere in this issue.

WESTINGHOUSE vs. THE GENERAL ELECTRIC COMPANY—SUIT TO ENJOIN THE USE OF OIL-INSULATED CONVERTERS.

On Monday, April 24, a bill was filed in the U. S. Circuit Court for the Southern District of New York, by George Westinghouse, Jr., against the General Electric Company, for infringement of his Patent No. 366,362, issued July 12, 1887, entitled "Electric Converter."

This patent covers among other things the use of oil as a means of insulating converters; Claim 4, of the patent reading as follows:

> The combination, substantially as described, of an electric converter constructed with open spaces in its core, an inclosing case, and a non conducting fluid or gas in said case adapted to circulate through such spaces and about the converter.

The suit, though brought in the name of Mr. G. W. Westinghouse, in whose name the patent stands, is being prosecuted by the Westinghouse Company.

LITERATURE.

Dynamos, Alternators and Transformers. By Gisbert Kapp, M. I. E. E. *London*, 1893. Biggs & Co. Illustrated. 483 pages. 5 by 7 inches.

It is rarely that those who possess accurate knowledge on a subject are endowed with a gift of imparting it to others, and hence it is a subject of congratulation when the two are met with in the same person. Mr. Kapp is one of these and his previous works and writings have been of such assistance to students that they will welcome the appearance of the present work.

It has been held in some quarters that science and its direct application should not be made too easy, lest the student, be apt to lose sight of fundamental principles, in the hurry to seize upon and apply the results based upon those principles. But we believe this danger to be greatly exaggerated and that principles are brought out best by actual practice.

Mr. Kapp's object in the work before us has been to make it easy for the engineering student to apply practically the principles of electricity and magnetism to the construction of dynamos, alternators and transformers. For that purpose he takes it for granted that the student has a certain amount of preliminary elementary knowledge; and he therefore wastes little time in getting down to the subject in hand. In the treatment of the subjects included in the work, the author has adopted the admirable course consisting in first stating the general rules that underlie the calculation of the various parts of dynamos, and then showing their application by taking an actual example and working it out numerically. In this way there is worked out the complete design of both the magnetic and the electrical details of the continuous current machine. We also find valuable information on methods of armature winding, and the calculation of potential for various types of armature, both bipolar and multipolar, drum and Gramme armature.

The same method is also carried out in connection with alternating dynamos and the various effects of self-induction, and the armature reaction in such machines is clearly pointed out. In this section of the work as well as in that on the transformer, the author has made frequent use of graphical methods of calculation. It goes without saying, that a work of this kind cannot be absolutely free from mathematical formula, but the mathematics contained in the present work will offer no difficulty to those who have gone through an ordinary high school course.

There are other, more elaborate, works on the subjects here treated, but we are free to say there is none which will prove more satisfying to the wants of the student and electrical reader than the present volume. We can heartily recommend it.

The Transmitted Word. By W. J. Keenan & James Riley. *Boston*, 1893. Dorchester Press Co. 113 pages. 5 by 7 inches. Price, cloth, 75 cents.

There is probably still a large section of the community whose knowledge of the action of the telephone is hazy in the extreme, and to such an easy explanation of its functions will be welcomed. The authors in the little work before us have attempted to present in an entertaining style what the telephone is, and how it does its work. The descriptions are entirely free from technicalities, and will serve to pass away a leisure hour with profit. The literary work is charming.

Chart of the Telegraph Lines and Submarine Cables of the World. By Paul Gacottey & Maxime Mabyre. *Paris*, 1893. Chas. Delagrave. Price, 75 cents.

This chart measuring 25 x 40 inches shows the location of all the lines of the International Telegraphic System and of submarine cables, the rate per word of every country, including press dispatches, and the essential difference between the different telegraphic administrations. The chart is very clear and has evidently been prepared with great care. It indicates no less than 1,168 submarine cables; of these 880 belong to various governments and aggregate 14,480 knots, while 228 belong to private companies aggregating 125,000 knots.

General Specifications of Wiring for Electric Light in Buildings. By *Robert A. Cummings.* Published by the author. Columbus, O., 1893. 10 pages. 6½ x 9 inches. Paper cover. Price, 25 cents.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 76th meeting was held at the headquarters of the Institute, 12 West 31st street, Tuesday, April 18th, at 8 p. m.

The paper presented was entitled "Impedance," by A. E. Kennelly, of the Edison Laboratory, Orange, N. J.

The Annual Meeting of the Institute, for the election of officers, etc., will be held at the same place, Tuesday, May 16th. The General Meeting for the reading and discussion of papers, will be held the following day.

The official ballots with instructions concerning the same, have been mailed. The Council has nominated a ticket with Mr. T. D. Lockwood at the top for president. An opposition "members'" ticket, headed with the name of Prof. E. J. Houston, for president, has been issued, supported by Edward Weston, Prof. Elihu Thomson, F. J. Sprague, Nikola Tesla, F. L. Pope, A. E. Kennelly, G. M. Phelps, A. S. Brown, Moses G. Farmer, Dr. Pupin, Dr. S. S. Wheeler, Prof. F. B. Thomas, F. W. Jones, Prof. F. B. Crocker and a great many others in the different branches of electrical research and industry.

NEW ELECTRIC RAILWAY POWER HOUSE AT PEORIA, ILL.

On the morning of January 17, the power house of the Central Railroad was burned to the ground, entailing a loss of $100,000, with an insurance of about $75,000, the boiler room being the only part that was saved. Within ten days Manager Finley had rented the local "straw-board" mill, installed generators and had cars running on nearly all the lines. The Central Company have since rebuilt the power house on the old corner and are now running the cars from power derived from it.

The generator-room of the new plant is 80 x 95 feet, ten feet wider than the old. There are now in operation two engines and two generators of 500 rated horse-power each. A third engine and generator will be placed soon and the fourth later on, both of the above capacity.

There are six boilers of 250 h. p. each with a 1,000 h. p. heater for furnishing hot water to the boilers. The company intend to lay pipes to the river and pump their own water.

The car barn is 60 x 136 feet, with a fire wall dividing it lengthwise into two equal parts, each part containing three tracks, each capable of holding five cars, making a total capacity of 30 cars. The repair shop is 95 x 40 feet and separated from the engine room by a fire wall extending several feet above the roof. The buildings are all of one story.

Since the fire the Central Company have added five new 16-foot cars, with two W. P. single reduction 15 h. p. motors, to the Adams street division. Nine new cars are ordered and will be delivered in a few days. These cars will be used on the Bluff lines and will have two motors of 25 h. p. each.

The Central Company have elected the following officers for the ensuing year: Walter Barker, president; Sumner Clark, first vice-president; J. B. Greenhut, second vice-president; Eliot Callender, treasurer; Sam Woolner, Jr., asst.-treasurer; J. N. Ward, secretary; Sam Woolner, Jr., asst.-secretary; John Finley, general manager, and James Finley, superintendent. Sumner Clark, J. B. Greenhut, Sam Woolner, Jr., Eliot Callender, Walter Barker, J. N. Ward and H. R. Woodward, constitute the board of directors.

NEW YORK NOTES.

The Atlantic Improvement Co., of Long Island City, N. Y., have placed the contract for their new power station, consisting of an engine and boiler house and dynamo room with the Berlin Iron Bridge Co., of East Berlin, Conn.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED APRIL 11, 1893.

Accumulators :—

Electrode for Secondary Batteries, G. D. Coleman, Chicago, Ill., 495,107. Filed June 10, 1892.

Blows or showers the finely divided molten metal through a closed chamber or housing and receives it when near the point of congelation in a suitable mold.

Alarms and Signals :—

Electrical Indicator for Rudders, C. V. Knowles, Somerville, N. J., 495,047. Filed Feb. 16, 1892.

For indicating the position of a ship's rudder.

Electric Annunciator System, E. R. Wilder, Kansas City, Mo., 495,127. Filed June 28, 1892.

Adapted to indicate any one out of a number of wants after the attention of the clerk or operator at the office has been attracted. For hotels, apartment houses, etc.

Batteries, Primary :—

Electric Battery, F. M. Archer, New York, N. Y., 495,176. Filed Nov. 25, 1891.

Relates to arrangement and construction of cells.

Electric Battery, F. M. Archer, New York, N. Y., 495,177. Filed Nov. 25, 1891.

Similar to above.

Galvanic Battery, C. J. Coleman, Chicago, Ill., 495,306. Filed June 6, 1891.

Employs a porous lining of straw-board in surface contact with the zinc or outer electrode.

Clocks :—

Electric Alarm Clock, T. P. Adams, Rico, Col., 495,287. Filed May 23, 1892.

Distribution :—

System of Electric Conversion, E. W. Rice, Jr., Lynn, Mass., 495,299. Filed June 18, 1888.

A motor-generator system. Claim 1 follows:

In a combined electric motor and generator the motor portion of which is supplied from a conductor of approximately constant potential, a regulating or controlling coil for the generator connected to a point whose potential varies with the counter E. M. F. of the motor armature.

Dynamos and Motors :—

Electrical Motor, A. Knoche, Elberfeld, Germany, 495,046. Filed July 22, 1892.

A reciprocating motor.

Commutator-Connector, E. D. Priest, Lynn, Mass., 495,058. Filed Nov. 16, 1892.

For connecting the armature wires to the commutator segments.

Commutator-Brush, K. Koch, Elsey, Germany, 495,136. Filed Nov. 10, 1892.

Employs small metallic tubes instead of wires or strips.

Ignition :—

Magneto-Electric Machine, J. N. McLeod, Brooklyn, N. Y., 495,138. Filed April 15, 1892.

Especially adapted to blasting machines. Operated by either a pull-up or a push-down movement.

Magneto-Electric Generator, J. N. McLeod, Brooklyn, N. Y., 495,139. Filed April 27, 1892.

Similar in purpose to the above.

Lamps and Appurtenances :—

Electric Arc Lamp, A. G. Waterhouse, Hartford, Conn., 495,077. Filed Nov. 28, 1892.

Relates to the gravity-clutch type of lamps.

Incandescent Lamp, G. H. Benjamin, New York, N. Y., 495,240. Filed Nov. 14, 1892.

A two part lamp. Claim 1 follows:

An incandescent lamp comprising a filament, leading in wires, an inclosing chamber composed of two sections, and a wire formed of a metal interposed between said sections. Described in THE ELECTRICAL ENGINEER, April 19.

Globe Holder for Arc Lights, T. H. Faben, Toledo, O., 495,318. Filed Oct. 14, 1891.

Electric Arc Lamp, R. M. Hunter, Philadelphia, Pa., 495,461. Filed Aug. 23, 1892.

Adapted for search lights and the like. Employs a condenser lens for concentrating the rays of light and projecting them in one direction. and an electric motor for vibrating the condenser lens.

Electric Arc Lamp Carbon, G. M. Lane, Asbury Park, N. J., 495,463. Filed Sept. 11, 1890.

Employs a series of carbon rods in parallel, united by a web portion, instead of a single circular rod

Incandescent Lamp, H. Green, Hartford, Conn., 495,462. Filed Oct 16, 1891.

A stopper lamp. Described in THE ELECTRICAL ENGINEER April 19.

Measurement :—

Voltmeter and Amperemeter, E. Gengenbach, Schenectady, N. Y., 495,086. Filed May 13, 1892.

Employs a solenoid having therein a magnetizable drum of sheet metal of varying width, and a movable part free to rotate around the drum; the movable part acts against a spring.

Potential Indicator, G. A. Lintner, Minneapolis, Minn., 495,225. Filed Nov. 17, 1892.

Employs audible signals, actuated by the indicator, to call attention to an increase or decrease of potential.

Metallurgical :—

Process of and Apparatus for Treating Ores, J. F. Wiswell, West Medford Mass., 495,212. Filed May 10, 1892.

An electrolytic process.

Metal Working :—

Apparatus for Electric Welding, C. L. Coffin, Detroit, Mich., 495,393. Filed June 11, 1891.

Employs an electric arc in close proximity to the parts to be welded.

Claim 1 follows.

In a machine for electrically heating metal, the combination of a pair of movable and rotating clamps, a furnace between them, means for opening and closing said furnace, and mechanism for maintaining an electric arc within said furnace.

Machine for Electrically Welding Metals, C. L. Coffin, Detroit, Mich., 495,394. Filed Apr. 8, 1892.

Similar to the above.

Miscellaneous :—

Spool for Electric Coils, G. W. Demmick, Lynn, Mass., 495,026. Filed Nov. 28, 1892.

Adapted to carry the great weight of copper used for field magnets in large dynamos.

Multiple Thermal Cut-Out, W. S. Hill, Boston, Mass., 495,088. Filed Aug. 10, 1889.

A safety device. Consists in uniting a series of cut-outs in a single device, in which one in use may be removed and another substituted instantly without danger.

Compressed Air Apparatus, E. Thomson, Swampscott, Mass., 495,071. Filed July 11, 1891.

Employs the heating effect of an electric current to assist the expansibility of compressed air before it is allowed to expand; as in the operation of drills, etc.

Electro-Magnet, S. H. Stupakoff, Pittsburg, Pa., 495,125. Filed Sept. 5, 1892.

Employs a strip or sheet of magnetic material for conducting currents of residual magnetism from one pole of the magnet to the other.

Electro-Mechanical Steam Engine Recording Indicator, R. G. Collins, Dollar Bay, Mich., 495,148. Filed May 2, 1892.

Railways and Appliances :—

Electric Railway Trolley, F. Heath, Minneapolis, Minn., 495,085. Filed July 11, 1892.

Relates to the trolley base and joint.

Railway Danger Signal, A. W. Berne, New York, N. Y., 495,193. Filed Aug. 5, 1892.

Signal on a locomotive for indication of danger at switches, drawbridges, etc.

Electric Street Railway Sweeper, J. W. Fowler and J. Hütton, Brooklyn, N. Y., 495,321. Filed May 6, 1892.

A double ended snow-sweeper. Patent relates to the sweeping mechanism.

Overhead Contact Device and Switch, C. J. Van Depoele (deceased), C. L. Coffin and A. Wahl, Administrators, Chicago, Ill., 495,383. Filed June 18, 1888.

Claim 1 follows:

In electric railways the combination of a supply conductor suspended along the line of travel, a car or other vehicle having a support extending upward from the upper part thereof, and an arm hinged and pivoted to swing freely upon the support, and carrying a contact adapted to engage the suspended conductor.

Traveling Contact for Electric Railways, C. J. Van Depoele (Deceased), C. L. Coffin and A. Wahl, Administrators, Chicago, Ill., 495,443. Filed March 12, 1887.

Claim 1 follows:

The combination of a car, an overhead conductor above the car, an upwardly extending and laterally movable arm carried by the car and having its upper end free, and a contact device carried by the arm at its free end, and making underneath contact with the conductor.

Conduit Electric Railway, W. R. De Voe, Shreveport, La., 495,456. Filed Sept. 6, 1892.

Employs a surface conductor and trolley.

Telegraphs :—

Means for Telegraphing, W. H. Fahrney, Chicago, Ill., 495,030. Filed Oct. 22, 1892.

For amplifying audible signals so as to make them heard at great distances. Employs fluid pressure and a resonator and electro-magnetic apparatus.

Telephones and Apparatus :—

Central Office Apparatus and Circuit for Telephone Exchanges, E. J. Hall, Morristown, N. J., 495,087. Filed Oct. 13, 1892.

Divides the main switchboard into two distinct portions, at one of which all calls are received and answered, and at the other of which the desired connections are made.

Granulated Material for Transmitting Telephones, W. W. Jacques, Newton, Mass., 495,090. Filed March 13, 1891.

Consists in coating grains of carbon with powdered alumina and subjecting the coated grains to an intense white heat in an inert atmosphere.

System for Protecting Telephone Apparatus from Lightning, J. J. Carty, New York, N, Y., 495,179. Filed Aug. 5, 1892.

Especially applicable to the same inventor's bridging-bell system, as described in his patent of March 31, 1891, No. 449,106.

Telephone Gauge, J. J. Carty, New York. N. Y. and F. A. Pickernell, Newark, N. J., 495,180. Filed Aug. 31, 1892.

For standardizing receiving telephones. Employs a piece of magnetic material of sufficient length to span the rim of the telephone shell; the weight of the piece being such that a magnetic field of standard strength will just sustain it.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED APRIL 18, 1893.

Accumulators :—

Secondary Battery, L. B. Rowley, Ashland, Wis., 495,638. Filed Sept. 28, 1891.

Consists of a plate made up of a series of tubes or porous non-conducting material, in each of which is inclosed active material and an electric conductor.

Alarms and Signals :—

Electrical Bell, H. B. Porter, New York, N. Y., 495,564. Filed Oct. 26, 1891.

Time Indicator and Signal for Races, A. Bartlett, Auckland, New Zealand, 495,770. Filed March 24, 1892.

Designed for use in starting races and indicating their results.

Batteries, Primary :—

Ground Generator of Electricity, M. Emme, Oakland, Cal., 495,582. Filed Aug. 29, 1892.

Employs a prepared body of earth as the support and exciting medium for the electrodes or elements. The spaces between the several couples are occupied by unprepared earth.

Conductors, Conduits and Insulators :—

Insulator, L. Hills, New York, N. Y., 495,552. Filed Aug. 22, 1892.

A clamp insulator.

Dynamos and Motors :—

Dynamo-Electric Machine, T. L. Willson, Brooklyn, N. Y., 495,538. Filed March, 8, 1890.

Relates to the open coil type of dynamo and cylindrical armature.

Combined Electric Motor and Driven Machine, R. Fuller, Detroit, Mich., 495,547. Filed March 31, 1892.

Makes the electric motor a part of the frame of the machine.

Commutator for Dynamo-Electric Machines or Motors, B. S. Paterson, Gateshead, England, 495,561. Filed Aug. 16, 1892.

Designed for perfectly securing mica strips in position between commutator sections.

Field Magnet, F. A. Perret, Springfield, Mass., 495,562. Filed Oct. 28, 1892.

Field-magnet core constructed in two parts, each part including a polepiece, and the parts connected by a wedge or V-shaped joint.

Electric Rotary Drilling Machine, R. M. Jones, Salt Lake City, Utah, 495,-788. Filed June 30, 1892.

Relates to the feeding mechanism for the drill.

Electric Motor or Generator, W. Koedding, St. Louis, Mo., 495,941. Filed Sept. 21, 1891.

Relates to the details of the armature and the arrangement of the field magnets.

Electrolysis:

Electrolytic Apparatus, G. O. Rennerfelt, Stockholm, Sweden, 495,600. Filed Sept. 30, 1890.

The cathode, extending into the electrolytic vessel, has a cavity, and a suction pipe connected with it. The exterior of the cathode is of non-conducting material, the interior of conducting material.

Lamps and Appurtenances:—

Electric Arc Lamp, F. T. Schmidt, Bradford, Eng., 495,601. Filed Aug. 24, 1892.

Regulating mechanism.

Incandescent Electric Lamp, E. W. Applegate, Chicago, Ill., 495,620. Filed Jan. 8, 1893.

Claim 1 follows:

In an incandescent electric lamp, the combination of an inclosing globe or bulb, a plug or stopper adapted to fit the neck of said globe or bulb, and a separating strip or ring of metal, or metallic alloy, which ring or strip is interposed between said plug or stopper and the said bulb or globe so as to separate them at the surface of sealing, and yet form with them a complete, inclosing air-tight chamber.

Electric Arc Lamp, W. A. Turbayne, Detroit, Mich., 495,643. Filed July 1, 1892.

Regulating mechanism.

Electric Arc Lamp, C. F. Adams, Morrison, Ill., 495,649. Filed Dec. 19, 1892.

Regulating mechanism.

Electric Lamp, T. Hudson, Baltimore, Md., 495,676. Filed Oct. 7, 1892.

Relates to a lamp fixture.

Electric Arc Lamp, E. E. Beauvalet and L. C. Beauvalet, Paris, France, 495,772. Filed July 11, 1892.

Differential regulating mechanism.

Electric Lighting System, H. Edmunds, Jr., London, Eng., 495,982. Filed Oct. 19, 1892.

An arrangement for turning on or off the lights in apartments, and for controlling the number to be lighted or extinguished.

Incandescent Electric Lamp Holder, L. C. Whitney, Jr., Milwaukee, Wis., 495,951. Filed Dec. 10, 1892.

Metallurgical:—

Magnetic Ore Separator, G. G. Crosby, New York, N. Y., 495,608. Filed Jan. 27, 1892.

Employs a magnetized drum or wheel in two sections separated by non-magnetic material. The sections of the drum or wheel are magnetized by coils around the spokes within.

Process of Extracting Zinc by Electrolysis, J. Pfleger, Frankfort-on-the-Main, Germany, 495,637. Filed Aug. 24, 1892.

Claim 2 follows:

The process of obtaining zinc by electrolysis out of a zinc-containing anode which consists in adding to the bath a basic zinc salt solution adapted to act as electrolyte, to which basic zinc salt solution, a conducting neutral salt has been added.

Metal Working:—

Electric Welder for Wire Fence Machines, J. D. Curtis, Worcester, Mass., 495,626. Filed Nov. 2, 1892.

Interposes an electric welder between the barbing mechanism and the wire supply mechanism, so that unbroken lengths may be fed to the barbing mechanism.

Miscellaneous:—

Insulated Pipe Joint or Coupling, T. J. Pierce, Philadelphia, Pa., 495,518. Filed Aug. 19, 1892.

Especially adapted for gas fixtures where electric wires are conducted through them.

Ship's Log, C. F. Holt, New Condon, Conn., 495,587. Filed July 25, 1892.

For indicating and registering the speed of vessels.

Lightning Arrester, E. Thomson, Lynn, Mass., 495,714. Filed August 5, 1889.

Relates to the manner of connecting lightning arresters used upon lighting or power circuits.

Claim 1 follows:

The combination with an electric line, and a dynamo machine connected to such line and to ground, of a lightning arrester consisting of two electrodes normally insulated from one another by a narrow insulating space, and placed in a shunt around the dynamo from the line to the wire or connection leading from the dynamo to ground.

Electric Shoe Sole, R. F. Carnes, Winfield, Ala., 495,782. Filed Dec. 22. 1892.

Lightning Arrester, E. Thomson, Swampscott, Mass., 495,853. Filed Feb. 15, 1892.

Claim 1 follows:

The combination in a lightning arrester or discharge protector, of a discharge path around the apparatus to be perfected, comprising a protective spark gap or set of gaps, with means for breaking down the dielectric in the gap and thereby enabling the passage of currents of lower potential than than that by which the dielectric is first broken down.

Electric Belt, G. F. Webb, Cleveland, O., 495,861. Filed Dec. 16, 1892.

Electric Cigar Lighter, W. Carter and C. E. Willey, Louisville, Ky., 495,929. Filed July 18, 1892.

Apparatus for Preventing Obstructions to the Flow of Oil in Oilwells, F. Gardner, Chicago, Ill., 495,936. Filed June 20, 1892.

Employs an electric heater adapted to be placed in the bore of an oilwell and to remain there.

Railways and Appliances:—

Cross-over Switch for Electric Railways, F. B. Rae, Detroit, Mich., 495,615. Filed Apr. 11, 1891.

Rail Circuit Closing Contact, F. von Hefner-Alteneck, Berlin, Germany, 495,674. Filed Jan. 18, 1893.

For closing an electric circuit from a railway rail by the agency of the downward deflection of a small portion of the rail by the weight of a passing engine or train.

Trolley Wire Finder, C. G. Cleminshaw and W. H. Bradt, Troy, N. Y., 495,-692. Filed June 22, 1892.

A finger is supported by the trolley arm in the plane of the trolley groove and normally located below the top of the trolley. Means are provided for projecting the finger above the trolley.

Electric Railway Trolley, W. Dunaan, Alleghany, Pa. 495,695. Filed July 20, 1891.

Relates to the trolley support.

Danger Signal for Railway Crossings, J. S. Savage, Jr., Detroit, Mich., 495,-918. Filed June 4, 1891.

To indicate the approach of a train from either direction. Passing train removes the danger signal and sets it again.

Electric Trolley, J. W. Kenevel, Chicago, Ill., 495,940. Filed March 26, 1892,

Telegraphs:—

Method of Indicating Telegraphic Messages, J. Levi, New York, N. Y., 495,744. Filed Jan. 16, 1893.

A cipher or code system of signaling.

OBITUARY: GROSVENOR P. LOWREY.

ELECTRICAL ENGINEER.

G. P. Lowrey.

GROSVENOR PORTER LOWREY, son of William and Olive Rouse Hubbard Lowrey, was born in Little York, now North Egremont, Mass., Sept. 25, 1831. He received an ordinary common school education in his native town, and completed his studies in Lafayette College, Easton, Pa., in which town he was admitted to the bar in 1854. Upon the appointment of his law preceptor, Andrew H. Reader as first governor of Kansas, Mr. Lowrey accompanied him thither, where he became an active participant in the stirring scenes of the "Free State" war. In 1856 he was driven away, with large numbers of other Free State men, by the acts of the so-called "Border Ruffian" legislature of 1855. In 1857 he commenced the practice of law in New York City, and soon became eminent in his profession. For many years he was a member of the leading law firm of Porter, Lowrey, Soren & Stone. Upon the accession of William Orton to the presidency of the Western Union Telegraph Company in 1866, Mr. Lowrey was appointed general counsel of the company, and discharged the multifarious and difficult duties of that position with consummate ability for a period of 15 years.

Among the more important litigated cases involving electrical questions in which Mr. Lowrey has borne a leading and distinguished part, may be mentioned the great Quadruplex telegraph case; the Western Union and American Union Consolidation case, and the Colgate Submarine Cable case, in each of which enormous pecuniary interests were involved. For some years past he has acted as legal adviser for Henry Villard, in his numerous enterprises.

One of the most important services which Mr. Lowrey has ever performed, was in furnishing and procuring the necessary financial backing for Thomas A. Edison, in bringing out and perfecting his system of incandescent lighting. With characteristic pertinacity, Mr. Lowrey stood by the inventor through thick and thin, in spite of doubt, discouragement and ridicule, until at last success crowned his efforts. In all the litigation which has resulted from the wide-spread infringements of the Edison patent, Mr. Lowrey has ever borne the burden and the heat of the day, and, perhaps, in no other field has he so personally distinguished himself, as in the successful advocacy of the claims of Edison to the invention of the incandescent lamp and everything thereunto appertaining.

In private life Mr. Lowrey was esteemed and beloved, it is not too much to say, even by his enemies. Let him strike as hard as he would—and no man could strike harder, in a cause which he believed to be just—it was impossible to feel a shadow of resentment towards the man himself. There was a transparent honesty of purpose, a polished keenness of repartee and an exuberance of genial and quiet humor, that was impossible to be resisted. As an after-dinner speaker, those who knew him best, knew him to have been without a peer. His genial fancy roamed untrammelled, "from grave to gay, from lively to severe;" a more charming companion in hours of recreation, it is impossible even to imagine.

When a young man, in straitened circumstances, he was accustomed to defray some portion of his educational expenses by teaching peripatetic singing schools in the villages of Western Massachusetts, a fact which he occasionally delighted to recall to the memory of two of his quondam pupils of those far-off days, Franklin L. and Ralph W. Pope.

Mr. Lowrey was twice married. His first wife was Laura, daughter of Francis Tryon, Esq., of New York, by whom he had five children. His second wife was Kate, eldest daughter of Hon. John Douglas Armour, Justice of the Court of Queen's Bench for Ontario, by whom he had one child, and who survives him.

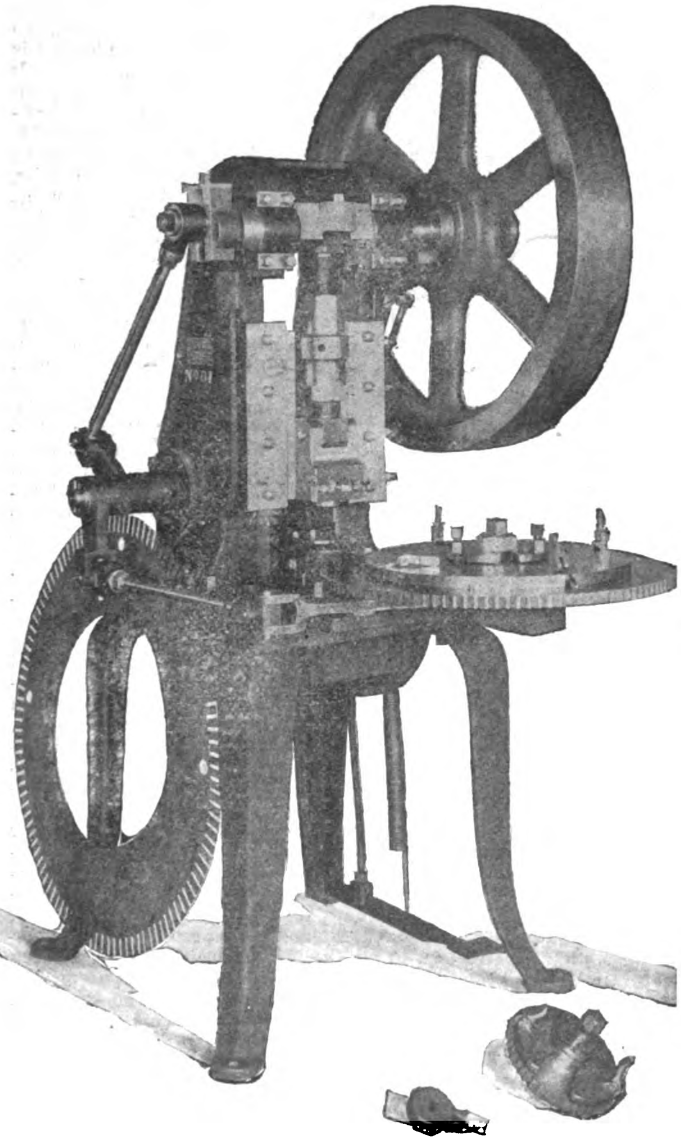
F. L. P.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE NO. 61 BLISS PRESS WITH AUTOMATIC INDEX FEED FOR CUTTING ARMATURE DISCS.

This machine is especially designed for cutting the notches in the circumference of armature discs for electric motors and generators. The disc is securely guided and clamped on the revolving plate which at its lower edge has as many teeth as there are notches in the circumference of the disc. The operator starts the machine by putting his foot on the treadle, causing the disc to revolve one notch after each stroke of the cutting punch. When the last notch is cut he releases the treadle, which causes the machine to stop ready for the introduction of another disc. The machine is adjustable in diameter from 10 inches to 84 inches and more if required. The weight of the machine is about 1,700 pounds. An armature disc punched on this press is shown at the left of the cut.



Bliss Automatic Press for Cutting Armature Disc Teeth.

There are a number of these in use by large electric companies. Any further information or particulars may be obtained from E. W. Bliss Co., 145 Plymouth street, Brooklyn, N. Y.

Helios Lamps.—The Ansonia Electric Company who are the General Western Agents for the Helios arc lamp, are having excellent success with the same. They recently placed a very large number of these lamps in Salt Lake City, and report two very large sales to central stations in Chicago.

WESTINGHOUSE ENGINES.

The works of the Westinghouse Machine Co. have been running for a year with a full night force. The shops are crowded with a large amount of heavy work in addition to their regular line of manufacture. There are now coming through ten 600 h. p. compound engines, of which eight are for the Philadelphia Traction Company, for direct coupling to multipolar generators, and two are to fill an order placed by E. D. Leavitt for the Calumet and Hecla mines, to be used in driving electric pumps for mine drainage. The company has just completed the shipment of six 1,000 h. p. engines for the Westinghouse Electric Company, to be used in filling its contract for lighting the World's Fair. These engines are also coupled direct to 1,000-light generators. They stand 18 feet high and make 200 revolutions per minute.

THE LEAD PENCIL MIGHTIER THAN THE PEN.

Ex-President Harrison, whose handwriting is as clear, precise and neat as that of a woman, said, after writing his annual message with a lead pencil, "My thoughts flow more freely from the pencil." Other eminent men, who have felt the weight of great responsibilities, have been conscious of nervous irritation, mental friction and general exhaustion when using a pen, and an almost entire freedom from such ills when using a pencil with a smooth and easy yielding lead. General Grant, in writing his important papers, used a Dixon "American Graphite S M" and commended it for its unequaled qualities.

The use of a lead pencil has saved many a writer and telegrapher from penman's cramp, and made it possible to do better work with greater ease.

A CONTRACT AT ATLANTA, GA.

The Lithia Spring Railroad Company, Thomas Camp, secretary, 8 Wall street, Atlanta, Ga., desires to contract with a good construction company to build and equip four miles of electric railway over the streets of the city, 25 per cent. to be paid upon the completion of the work and 75 per cent. within six months. The company will offer guarantees.

THE UNITED ELECTRIC IMPROVEMENT COMPANY.

The Heisler Electric Company, of Philadelphia, has changed its name to the United Electric Improvement Company. This change has been decided upon by the stockholders after having adopted definite plans for the extension of the business, and marks a very important departure. The extension will involve the erection of a new factory building with the addition of new tools and a general increase of facilities, thus equipping the company thoroughly for the successful manufacture of all types of lighting and power apparatus, and enabling it to protect itself fully in the broad field of competition. It is a step which should tend most advantageously to the electrical public, in the way of securing a wider range in the selection of first class apparatus, and helping to ensure moderate prices. Mr. Walter T. Smith, the general manager, informs us that it is the intention to push business very vigorously under the new régime.

"OUR BABY."

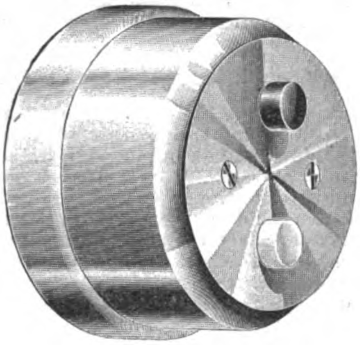
A novelty in the incandescent lamp line is being exhibited by the Electric Appliance Company, of Chicago. It is the latest thing out in the Packard lamp line, being a small 6 c. p. lamp with a bulb about 1¼ inch in diameter mounted to fit any regular socket and of any ordinary voltage up to 52 volts. It is known as "Our Baby."

No Building Complete Without It.—Out of all the buildings under construction in New York city since January 1st for which the architects' specifications name electrical equipment, two only are using other than the Interior Conduit system. The metal-covered conduit is now generally insisted upon by architects for the best construction. It is estimated that in the remodeled residence of Cornelius Vanderbilt at Fifty-seventh street and Fifth avenue, 100,000 feet of brass-covered Interior Conduit will be used by the Tucker Electrical Construction Company who have the work in hand.

The "New Sunbeam" Lamp.—We had occasion to state in our editorial of a few weeks ago that the Sunbeam Company was working on a new lamp, and in this issue of our paper appears an advertisement of The Ansonia Electric Company, Chicago, announcing the fact that the lamps are now ready for the market. We have no doubt that the demand for these lamps will be enormous.

THE "KLEIN" PUSH-BUTTON AND WALL SWITCHES.

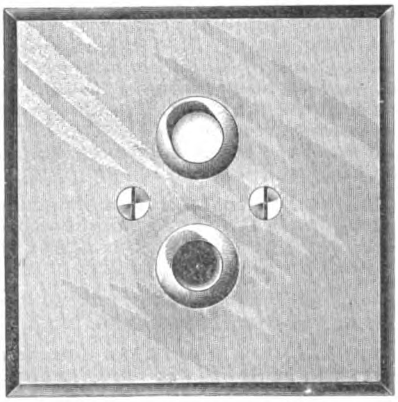
The Interior Wiring & Fixture Co., 14 Clinton Place, New York City, have just brought out some very ingenious and useful switches for special uses in interior work, due to the inventive genius of their Mr. Klein. We illustrate two of them on this page. One is the Klein push-button switch for electric light circuits.



The Klein Push-Button Switch.

The size shown is of eight ampere capacity, single pole, and is a regular style suited for surface work. Its use will enable the occupant of house or office to know whether the circuit is "on" or "off" by simply pressing the white button on the black. The cut shows the actual size of the switch which is finished in polished brass or gilt, or other styles to order, the base being of porcelain.

The Klein flush or wall switch which we also show, is of the regular form. A neat plate, nickel-plated, with bevel edges, is fastened to the cover. The switch itself is set into the wall or partition, only the plate and buttons showing. This makes the smallest and neatest switch possible. It is no larger than the ordinary type of gas key or push-button used for electric gas lighting. The switch itself is entirely enclosed, and is perfectly safe to use concealed with a flush plate cover.



The Klein Flush Wall Switch.

Another form of the Klein push-button switch is that of a pendant or flexible cord switch, for controling chandeliers, brackets, ceiling lights, etc. The button end is lowermost, and by simply pushing the buttons the purpose is accomplished. These novelties certainly add greatly to the convenience and availability of the incandescent light.

"BOMBSHELL" AFTER ALL.

> **The** "bombshell" seems to have been a firecracker after all.
>
> Again we would rise to remark to our esteemed, tan-tinted pentagonal contemporary which knew so much about the Goebel lamp that it is best "not to kno so much that ain't so."—*N. Y. Elec. Rev.*, Feb. 25, 1893.

Be it not in us to indulge in recrimination, nor to take delight in vainglory and abuse over personal or journalistic triumphs; but we are glad to point out to our good friends of the *Review* that their jibe was a little too previous. The Engineer was, as everybody knows, the first to recognize the importance of the Goebel defence and the first to print anything about it. Judge Hallett in St. Louis now decides that the Engineer's story was a literal "bombshell" after all, and that our judgment was pretty sound in treating it as such.

NO TELEPHONES FOR THE ARMY.

The Second Controller of the Treasury Department has decided that telephones for the army are not authorized under any known law. Some one wanted to erect a telephone at Fort Grant, Ariz., between buildings at that post at distances which the Controller thinks ridiculously short.

The Signal Service may carry its telephone as it does, by an arrangement of portable reels, by which it may throw out a line with rapidity from a scene of battle to the rear, but beyond this feature of the Signal Service the Controller has decided that the purchase of telephones cannot be made out of the appropriation for contingent expenses or that for incidental expenses for the army.

RIVER POWER AT WHITE HILLS, COL.

A novel electric plant will shortly be established near White Hills, Col., says the *Progressive Age*. Two large barges will be moored in the Colorado river, and on the barges will be placed an immense water wheel, to be driven by the river current. By a system of gearing, the power derived from the wheel will be used to drive a large dynamo or generator. The electrical power generated will be transmitted to White Mills, where it will be used as motive power in the mines and mills.

AN OHIO ELECTRIC MINING SCHEME.

Before the Ohio Institute of Mining Engineers Mr. Houston, of the Thomson-Houston Company, recently delivered an address in which he stated that the present system of horse-power in the mines costs 1½ cents per ton, whereas electric power for moving coal, lighting the mine and mining coal can be secured at a cost of only ⅞ of a cent per ton. Mr. Houston then made a statement to the effect that arrangements are on foot to establish an electric power plant in the Hocking Valley, which will supply sufficient power to operate all the mines within a radius of 11 miles. The plan is to carry current at 650 volts to the mouth of the mines and 250 volts into each mine. Mr. Houston stated that it is proposed to have the plant in operation by October 1, 1893.

WESTERN NOTES.

The Wirt Dynamo Brush.—We do not know of any better recommendation for an article than that it is chosen to replace some other article of the same class doing the same work. When one has a piece of machinery that is doing its duty fairly well, it needs extraordinary argument to cause it to be set aside and put something new in its place. The Wirt indicators, manufactured by The Ansonia Electric Co., seem to be enjoying just such distinction. Many central stations are replacing other indicators with the Wirt, not in any spirit of luxury, but because they have proved to be a positive economy in the matter of reduced lamp bills. The Wirt dynamo brush made by the same company is also winning its way rapidly into the favor of conservative and careful station managers.

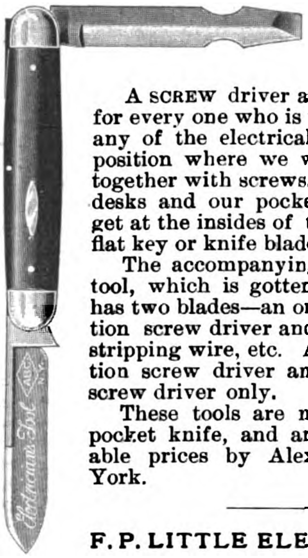
The Central Electric Company are kept very busy, filling orders. Their business in Okonite wire, Interior Conduit and supplies was never so great, and their large capacity for taking care of their customers is being tested to the utmost at this time. The new socket recently launched on the market by the Central Electric Company is meeting with favorable results, and it is being supplied in large orders. They are making a specialty of porcelain branch blocks, cut-outs, etc., and are having an unusual demand. Their pin and bracket factory is running night and day.

The Electric Appliance Company has taken the agency for the Diehl ceiling fans and have already secured a number of nice contracts for installations in Chicago stores and restaurants. The large equipment recently placed in the Peacock Annex of the Boston Oyster House is a standing advertisement for the Diehl fan. The Electric Appliance Company have recently made a number of small improvements in their Acme lamp socket. The new socket is being sold, however, at even a lower price than formerly, and the demand is very large.

Two Hundred Miles of Road have been equipped within three months by the Ansonia Electric Company, with their improved overhead railway appliances. They also report having secured some very large contracts within the last month, and are to be congratulated upon the success with which their new material has met.

Wirt Indicators.—The Ansonia Electric Company, are to furnish the Wirt indicators, both volt and ampere, for the new Chicago Athletic Building, and also for the Columbus Building. The Wirt indicators were recently furnished to the Lexington Hotel, and the Cicero Electric Light and Heat Company.

THE "A.B.C." SCREW-DRIVER KNIFE.



A SCREW driver and a knife are absolutely essential for every one who is in any way actively connected with any of the electrical trades. We have all been in the position where we were shown some new device put together with screws, and we have hunted through our desks and our pockets for a screw driver with which to get at the insides of the invention, but have had to use a flat key or knife blade for want of the proper article.

The accompanying cut shows a very handy pocket tool, which is gotten up in three different styles. One has two blades—an ordinary knife blade and a combination screw driver and knife blade, which can be used for stripping wire, etc. Another style has only the combination screw driver and knife blade, and the third has a screw driver only.

These tools are no larger in size than an ordinary pocket knife, and are put on the market at very reasonable prices by Alexander, Barney & Chapin of New York.

F. P. LITTLE ELECTRIC CONSTRUCTION AND SUPPLY COMPANY.

THE expansion of the F. P. Little Electric Construction and Supply Company goes steadily on. This company now occupies the entire building, No. 135 Seneca street, Buffalo, N. Y., and is not only the largest and most important enterprise of this kind in Buffalo, but is considered headquarters for electrical supplies of all kinds in that section of the country. In the cellar of the building we find a heavy stock of wire, porcelain goods, hard rubber tubing and general electrical stores. The floor above—the main floor—is occupied by the sales and retail departments. Mr. Little reserving for his own use a commodious private office in the rear. Electrical supplies of all description are displayed for sale on this floor, including Case engines; dynamos, motors and fan outfits are also shown. On the floor above—the second floor—are the general offices, occupied by the officers of the company, the accounting department, etc.; back of these offices, on the same floor, is the glass-room where glass globes and incandescent lamps are stored. The laboratory is on the third floor, as is also the construction department, while on the fourth floor is the manufacturing department. This department is one of the most interesting, not only for the reason that much new and very fine machinery has been installed, but from the fact that a variety of interesting specialties are now being turned out; not only are these specialties being manufactured in the building, but such articles as binding posts, special screws, etc., are being made, which parts heretofore were purchased elsewhere and assembled —in fact, about one-half of the stock heretofore purchased will henceforth be manufactured.

The articles of special interest now being turned out by the company are the Kester improved arc lamp, rheostats, starting boxes and alternating fan motors. As has already been announced in THE ELECTRICAL ENGINEER, the F. P. Little Electric Construction and Supply Company has secured the services of Mr. J. H. Kester, the inventor and patentee of the lamp, as superintendent of its factory. In the improved Kester lamp a most perfect feed mechanism is attained, together with simplicity of construction, there being no solder or rivets used and only one spring. It is claimed that the lamp will consume less current than any other arc lamp when run in multiple in connection with incandescent lamps, as the feed is so perfect that the carbons come nearly into contact and a uniform and steady arc is thereby maintained.

The 110-volt lamp for direct current is now ready for the market. The factory will be in full swing turning out the other articles mentioned above by the 1st of June. Buffalo has proved such a successful distributing point that Mr. Little and his associates feel confident of continued and increased success with their amplified venture.

REYNOLDS-GARDNER. One of the notable events of the season in Boston society was the marriage on Tuesday, April 18, at 12.30 o'clock at Longwood of Miss Mollie B Gardner, daughter of Mr. Harrison Gardner, the well-known dry goods merchant, and Mr. Philip M. Reynolds, Treasurer of the Brown Electric Company and formerly for five years with the Thomson-Houston Company of that city. It was a very pretty ceremony and was attended by over 600 prominent society people from Brookline, Boston and New York. The nuptial knot was tied by Rev. George Strong assisted by Rev. Reginald H. Howe. Mr. J. C. White was best man, and Miss Ethel Gardner, a sister of the bride was maid of honor. There were no bridesmaids. After the ceremony a reception was held at the residence of the bride's parents, corner of Colchester and Kent Sts. On returning from their wedding tour the couple will reside in Milton.

C. E. WOODRUFF & CO.

MESSRS. C. E. WOODRUFF & CO. have opened a store for the sale of general electrical supplies at 235 Lake street, Chicago. This company was formerly the Globe Supply Company, and is now composed of Mr. Andrew Shillinglaw and Mr. John F. Fiegel. They have just made arrangements by which they will become Western agents for the well-known electric wires and cables and flexible conduit of the American Circular Loom Company, of Boston. The above-named gentlemen have had a large and varied experience in the electrical business and there is no doubt that success will follow their efforts in their new enterprise.

CHEAP ELECTRIC LIGHT POSTS MUST GO.

THE NEW YORK BOARD OF ELECTRICAL CONTROL a few years ago selected a post with an iron base costing $25 as the "pole" to be used for electric lights, and all others were forbidden. The electric light companies, however, erected cheaper poles. Last week, the board, on motion of Mayor Gilroy, ordered the removal at once of every post that did not comply with the specifications.

If this order is not obeyed the poles which are not according to rule will be cut down. The posts in Broadway and Sixth avenue, and some of those in the cross streets comply with the requirements. It will cost the electric light companies about $75,000 to make the change.

IMPORTANT ELECTRIC LIGHT CONSOLIDATION IN CHICAGO.

THE consolidation of the Chicago Arc Light and the Chicago Edison companies has been effected by a vote of the stockholders of both companies. The consolidated corporation, known as the Chicago Edison Company, will have a capital stock of $3,000,000. The board of directors is as follows: E. L. Brewster, R. C. Clowry, J. W. Doane, J. B. Drake, F. S. Gorton, Samuel Insull, Edson Keith, Robert T. Lincoln, E. M. Phelps, A. F. Seeberger, B. L. Smith, A. A. Sprague and Lambert Tree.

PHILADELPHIA NOTES.

THE HEISLER ELECTRIC CO. during the past two months has broken all records in the way of installing central stations. Among some of the larger ones just completed are those for the towns of Seguine, Columbus and Cuero, Tex.; New Smyrna, Fla.; Delevan and Niagara, N. Y., all of which are of the Heisler long-distance system. They have recently installed a plant for Edwardsville, Ill., with a new alternating system.

THE CUTTER ELECTRIC AND MFG. CO. have supplied the Great Northern Hotel at Chicago, with their automatic switches to be placed in the door of every room of the hotel. The unique switches are used for the purpose of cutting out the lights in the room when the guest leaves the room and locks the door. This prevents the guests of the hotel leaving the light burning when the room is unoccupied.

THE COPE ELECTRIC PILOT LINE CO. are running over 50 miles of draw wire through the 1¼-inch McDonald wooden conduit, for the Brush Electric Light Co. This company have the only machine which does this work successfully.

NEW YORK NOTES.

THE ELECTRIC SELECTOR AND SIGNAL COMPANY, of 45 Broadway, New York, will make in the Department of Electricity, space U 19, a complete exhibit of the principle of individual electrical selection in its several applications. The space allotted to the company has a frontage of 50 feet on the main balcony, thus affording ample room for the display of its specialties.

There will be shown in operation, on a scale and under the conditions of every-day practice, a number of railroad semaphores and train order signals, six telegraph stations, six arc lights, several groups of incandescent lamps, four electric motors and a telephone circuit with four or five stations. At one end of the space will be a stand representing a central light station at which will be located the transmitter for cutting in and out the electric lights and motors, and at the other end will be a similar stand representing a railroad train dispatcher's office from which the various signals and telegraph stations will be controlled.

The instruments and appliances while of standard pattern have all been finished ornamentally and all the wood-work will be of naturally varnished wood, thus heightening the effect, and making a display which it is believed will be as attractive to the casual visitor as it will be interesting to railroad and electric light men.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XV. MAY 3, 1893. No. 261.

THE CONDENSER IN ALTERNATE CURRENT POWER DISTRIBUTION.—I.

BY

William Stanley Jr.

FOR several years the problems presented in working out a practical method of distributing power by means of alternate currents have formed a portion of our laboratory work. In pursuing these researches and in studying the history of the subject, we have found that many attempts to operate motors by single and multiphase currents are recorded in the scientific and technical papers of the past twenty years. At the present time there are a number of methods of operating alternating motors, each of which differs from the others in some essential point, and all or any of which may be employed with success if combined with certain improvements which will be explained in these articles.

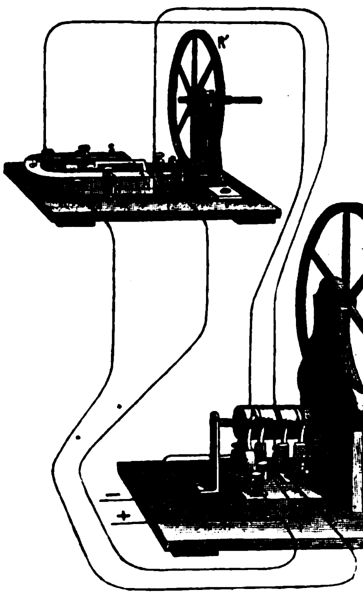


FIG. 1.—DEPREZ SYNCHRONOUS MOTOR.

To the question, Who first demonstrated a practical method of operating alternating motors? we would reply that in all probability Marcel Deprez was the first to clearly describe the operation of multiphase motors, having constructed and operated motors by two-phased currents in 1880, the principles of which he described in contemporary literature and before scientific societies. The Deprez motor is illustrated in Fig. 1, and consists of two armatures (or fields) mounted on a common shaft and arranged to be supplied by alternate currents differing in phase by 90 degrees. The stationary portion of the motor was in some cases a permanent magnet and in other cases was surrounded by a closed circuited winding which was inductively acted upon by each armature as it passed through the plane of induction during a revolution. Thus we see that Deprez constructed not only alternate current motors free of commutators acting upon closed armature coils, but also employed two alternate currents differing in phase to operate his machine. That Deprez fully understood the importance of his invention, and especially, that he fully conceived of a commutatorless system of power transmission may be gathered from the following claim of his English patent No. 4,128, of 1881, in which he says: "I claim the combination in one and the same circuit of an alternate current dynamo electric machine, and one or more alternate current electro dynamic machines without commutators, so as to insure synchronous and constant motion in all the machines irrespective of any resistance (mechanical), substantially as herein described."

It is not our intention in this article to relate the endeavors of other inventors to produce alternate current motors prior to the work of Deprez. Suffice it to say that several inventors made and operated motors by means of what is now termed shifting fields, by employing rotating armatures made of hard iron or steel, utilizing the retentive powers of such materials in combination with periodic currents and in other ways. The history of the subject but confirms the old adage that there is very little that is new under the sun. Nor is it our intention to compare the claims of the several engineers who each confidently assert that to them belongs the honor of first pointing out the useful properties of multiphase currents, whether such combination be employed for torque purposes, for rotary inductive actions, or for purposes of regulation of electromagnetic apparatus. What we shall attempt to show is that an entirely commercial distribution system of power, of lighting, and of transmission, has been built up by employing the simple apparatus of Deprez and adding thereto certain new elements and these completing a transmission system.

Before dealing with the problem in detail we will point out a condition incident to the operation of alternate current magnets, which is of the utmost importance in alternate current engineering work and design, and which has hitherto raised a serious obstacle to the developement of systems of power transmission by alternate currents. Fig. 2 represents a transformer having its secondary circuit connected to the coil of an electromagnet A A between the poles of which there lies an iron armature separated from A A by a small air gap (page 424).

Now it can be shown that the value of the magnetizing power fluxing the magnetic circuit of A A depends almost entirely on the number of turns on A A and not on the ohmic resistance of the coil, as would be the case if steady currents were employed, the total number of lines Z being found by the equation,

$$Z = \frac{E \times 10^8}{\sqrt{2}\,\pi\, n\, T}$$

where E = E. M. F. applied to A A in volts;
n = number of complete periods per second;
T = number of turns on A A.

We thus see from this equation that the number of lines permitted to pass through the coil on A A is greater as the frequency (alternations) and turns are less, and that the number of lines is quite independent of the magnetic reluctance of the circuit. Having chosen any certain value of magnetization for our magnet we can at once determine the number of turns to be wound upon it by transforming about the above formula to get the value of T. Thus:

$$T = \frac{E \times 10^8}{\sqrt{2}\,\pi\, n\, Z}.$$

Having chosen the number of lines for a magnet and having ascertained by calculation the number of turns with which to wind the core, we desire next to ascertain the value of the current in the circuit when the terminals are connected to a transformer. To do this we must first calculate the magnetizing power or ampere-turns required by the core of the magnetic circuit, just as when dealing with continuous current magnets. Now we know that the

ampere-turns or $M = \dfrac{d \times l}{3.2 \times \mu}$;

where d = number of lines per sq. in.;
l = length of magnetic circuit in inches;
μ = the permeability of the magnetized medium;

and to obtain the total magnetizing power we must apply this calculation to the two portions of the magnetic circuit independently, first, say, to the iron portion for which μ has usually some large value; and second, for the air gap portion when μ has the value, $\mu = 1$. The result of these calculations having been summed up we ascertain the total magnetizing power M to flux the circuit is, say, M = X ampere-turns, from which (dividing by T, the number of turns), we get the current required to magnetize the magnet,

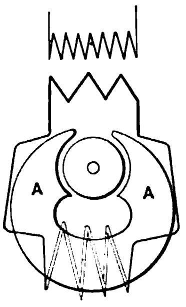


FIG. 2.

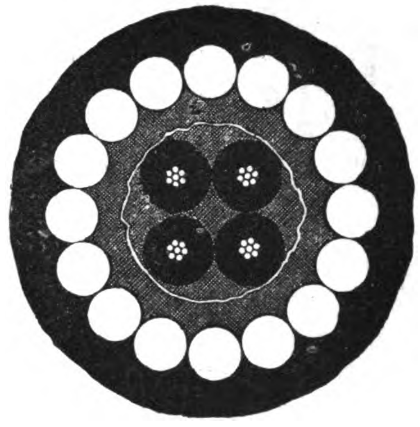
$$C = \frac{x}{T}.$$

In the preceding calculations we have neglected the resistance of the coil on A A, assuming it, as is usually the case, to be so small as not to materially affect the results.

LIGHTNING AND THUNDERSTORMS.

The Royal Meteorological Society recently devoted an evening to the reception of a paper from Mr. Shelford Bidwell on some problems connected with thunderstorms. He asserted that the origin of atmospheric electricity was quite as obscure as ever it was, in spite of the "evaporation" and "friction" theories. Having granted, however, that the electrification existed without reference to the cause of it, he pointed out that the ordinary phenomena of thunderstorms were not difficult to account for. Photography had proved of the greatest assistance in determining the actual force of the lightning flash. He stated that if Dr. Oliver Lodge's theory of the "impulsive rush" discharge be correct, lightning conductors, however well constructed, cannot be depended upon to afford absolute immunity to property upon which they are erected.

THE IRISH SEA TELEPHONE CABLE.[1]



Irish Sea Telephone Cable.—Full Size.

On April 4, her Majesty's Post Office telegraph ship "Monarch" successfully laid a new cable, containing four conductors of special size, designed for telephonic use between Great Britain and Ireland. The cable was laid between Port Kail on the Scottish Coast and Donahadee on the Irish Coast.

To ensure that the go and return land wires shall preserve the same mean distance from disturbing causes, they are made to exchange their positions, as in the case of the London-Dover section of the London-Paris line, by revolving round each other like the strands of a rope over the whole distance, about seven complete twists being made in every mile. The cable wires are twisted in a similar manner. At present only the Belfast-Glasgow circuit is completed, but a second pair of wires is erected as far as Stranraer on the way to Manchester, Liverpool, Leeds, and eventually London; whilst a pair is also just being commenced to Dublin, and will ultimately be extended to Cork. The Belfast-Glasgow line will be opened very shortly to the public. The charge for a conversation of three minutes will be $1.25. The tariff for the London-Paris line is, it will be remembered, $2.00 for a similar period.

The Belfast-Glasgow line is 150 miles long, and the cable 23½ nautical miles. The London-Paris line is 303 miles long, and its cable 21 nautical miles. Both cables are made to practically the same specification. The conductors are of 160 pounds copper, and the dielectric 300 pounds gutta-percha; the electrical resistance at 75° F. is 7½ ohms, and the electrostatic capacity .3 microfarad per nautical mile of 2,029 yards. Both cables have been made by Messrs. Siemens Bros. & Co. There is one point alone in which they differ. Surrounding the core of the Irish cable there is, as will be seen by our illustration, a sheathing of brass tape, intended to protect the conductors from the ravages of the teredo. This has not been considered necessary in cables laid heretofore in British waters, but the teredo has now made its appearance here and must be guarded against.

THE "NOVAK" INCANDESCENT LAMP.

After months of most careful and exhaustive experiments, the Waring Electric Company, a company recently organized, have perfected and have ready for the market the new "Novak" incandescent lamp, which will create an undoubted sensation as soon as it appears. The lamp is the invention of Mr. Waring, who has hitherto been connected with the Perkins Electric Lamp Company, and is an absolutely non-infringing lamp, depending not upon a vacuum, as its name implies, but the bulb containing a special gas which has many properties never before discovered. To all outward appearances the lamp is exactly the same as the Perkins lamp, but it is only necessary to look at the filament, to see that the bulb contains no vacuum, as the filament does not vibrate in the manner so well known to all who have handled incandescent lamps, proving that there is present a gas of such density as to prevent vibration. By breaking the lamp, one can have further proof of the presence of gas, but this means is not recommended as the odor of the gas is not particularly pleasant to the olfactory organs.

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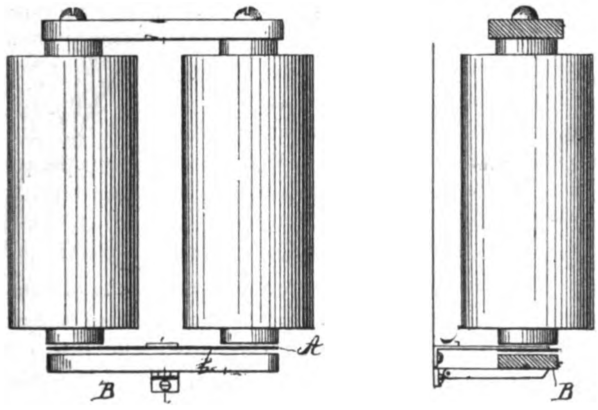
[1] *London Electrician.*

It is claimed for the lamp that it possesses as long life as, if not longer than, the average lamp, and has this distinct advantage over all other lamps, that its efficiency will remain constant until the filament breaks, the lamp burning as brightly as at first up to the last moment of its life. The "Novak" lamp is being put on the market by The Clafflin and Kimball Company, of Boston, who are sole selling agents, and who already have orders for many thousands of them.

"NON-STICKING" ARMATURE FOR ELECTRO-MAGNETS.

As is well known, considerable difficulty and annoyance is experienced in the use of the electromagnet by reason of the adherence of the armature thereto after the current has been cut off, such adherence being caused by the residual magnetism. Heretofore the effects of this residual magnetism have been destroyed by the interposition of a thin plate of diamagnetic material, as brass, between the poles of the magnet and the armature. This plate is made of such thickness as to hold the armature without the comparatively feeble field of force of the residual magnetism. Although a very thin sheet of diamagnetic material will effect this purpose, the use of such a plate is objectionable as it will, however thin, appreciably diminish the power of the magnet when excited, the power decreasing generally as the square of the distance of the armature from the poles of the magnet.

With the object of neutralizing the effect of the residual magnetism on the armature without, in any way, impairing its attractive effect when excited, Mr. S. H. Stupakoff, of Pittsburgh, Pa., has recently devised the arrangement shown in the accompanying engravings. In order to avoid the adherence of the armature after the current has been cut off, by reason of residual magnetism, a strip A of iron is interposed between the armature B and the poles, so as to extend across from one pole of the magnet to the other. This strip is made of sufficient size to absorb the lines of force of the residual magnetism emanating from the poles of the magnets, but does not constitute a sufficient path for the magnetic lines when the magnets are excited. The strip is supported a short distance away from the poles of the magnet by a resilient tongue attached at its outer end to the frame supporting the magnets, or it may be held in contact with the poles or permanently attached thereto.

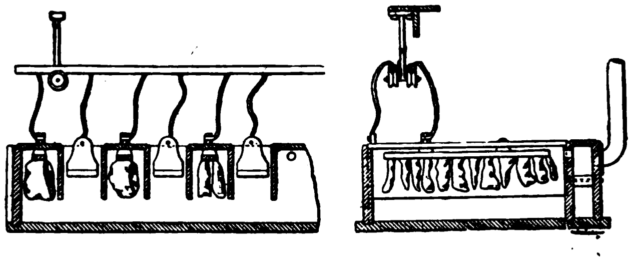


FIGS. 1 AND 2.—"NON-STICKING" ARMATURE FOR MAGNETS.

When the magnets are excited by the passage of the current, the strip, if held away by a resilient support, will be first attracted to the poles, but as the quantity of metal in the strip is insufficient to serve as a sufficient path for the magnetic lines from one pole of the magnet to the other, the armature will be drawn up against the strip, and as both strip and armature are of magnetic material, they will be practically an integral structure, the armature being held against the strip with nearly the same force as it would be held against the poles themselves. When the current is broken, the strip will act as a sufficient path for the residual magnetism in the cores and thereby free the armature from all material attractive force.

ELECTROLYTIC MANUFACTURE OF CAUSTIC SODA AND BLEACH.[1]

THE Electrolytic Caustic Soda and Chlorine Trust have erected a model works at Snodland, Kent, England, which is large enough to demonstrate the manufacture of caustic and bleach on a commercial scale. The plant consists of a 50 h. p. engine and dynamo. With these we are not concerned in the present case, as the efficiency of engines and dynamos is well known already. The dynamo gives 80 volts, and the circuit is led to the vat-room, the vats being connected in series. A pressure of six volts is allowed for each vat, which is somewhat high, but experience at Snodland has led to the adoption of that figure. The vats, Figs. 1 and 2, are made of slate. The anode chambers are closed with slate lids, with the lead backing of the anodes attached to the lower side by bolts passing through the lid, which also make the circuit. The cathode chamber is open to the air. There is no porous partition, the side of the anode chamber being merely carried down a little way into the liquid. The inventors consider this point of great value, on account of the saving of the resistance due to the porous diaphragm generally used.



FIGS. 1 AND 2.—VATS FOR ELECTRIC MANUFACTURE OF CAUSTIC SODA AND BLEACH.

The vats are of such a size that with six volts pressure the liquor gains 1 per cent. of caustic per day. It is generally run off at 4 per cent. The chlorine is led off and is conducted to milk of lime agitators, where it is absorbed, and to an ordinary bleach chamber. The milk of lime is best when the bleach is to be used at once, as at Snodland, where it is supplied to a large paper mill close to the works. The bleaching chamber is used to demonstrate the manufacture of ordinary bleaching powder. The caustic liquor, which still contains a large amount of salt is evaporated down. The salt crystalizes out, and is sent back to the vats again. The caustic made by this process is entirely free from sulphate and carbonate, and practically free from chloride.

Instead of trying to produce or discover some form of carbon which will not disintegrate when used as an anode, they approached the difficulty from another direction and looked for the cheapest possible form of anode. This they found in gas retort carbon in the crude form in which it is obtained from the gas-works. These pieces of retort carbon have two saw cuts made in them at one end, and are then cast into leaden backs. They are thus held in lead. The anodes are so arranged that the lead does not enter the liquid, so that it is not eaten away—chlorine gas having little corroding action on it. These anodes are very cheap, as retort carbon is almost a waste product, and the lead can be used over and over again. The cost of renewal of anodes of this description is very trifling.

The syndicate have secured the services of an experienced alkali manager, Mr. J. Leith, and have given him charge of the works. Mr. Leith, we are informed, makes the process give a balance of 46 per cent. above labor and material on a small scale at Snodland, where coal is 11 shillings per ton, and salt and lime 20 shillings per ton, and with an old and obsolete type of engine. In an alkali district, where coal, salt, and lime are cheaper, and with an efficient generating plant, he estimates the balance at 265 per cent. above prime works cost. This is, of course, an enormous margin, and shows that those who take up the manufacture of electrolytic soda at once may be able to make enormous profits before the price comes down.

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[1] *Industries.*

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Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
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THE INCANDESCENT LAMP SITUATION.

HE who would have friends must show himself friendly is an adage the truth of which was never more forcibly or sharply illustrated than in the present incandescent lamp situation. The Hallett decision in St. Louis, refusing to enjoin the Columbia Incandescent Lamp Company, was followed by an outburst of delight and expression of relief that will make the week memorable in electrical development in America, the more so because the feeling of pleasure was and is shared by large numbers of people who are not infringers of patents and who have no sympathy with attacks on patent property. We do not overstate the case when we say that the General Electric Company by its procedure and by the actions and threats of many of its agents had made enemies, in every branch of the industry, of men who believed that they and their legitimate investments in the electric arts were to be crushed under the iron heel of monopoly. Hence the General Company had few friends save those directly interested, and even its denials of an intent to be cruel lacked definiteness. Its policy has been to be without a policy. The uncertainty as to its blow has been worse than a direct and open assault could be.

To-day the latest Federal Court to declare its mind has deprived the General Co. of no little of its prestige, and of much of its power. From the first it appeared to us that the Goebel defence would be a serious obstacle, but the General Co. preferred to force the issue and to crowd out of the field every other lamp manufacturer. Upon control of the lamp patent it based, apparently, control of much other business; and the various local Edison Companies, which have given up large blocks of securities, as well as cash, for their franchises, naturally proceeded to warn everybody off their territory. The collection we have of their documents is curious reading at this moment, when the last Federal Court has practically declared that the Edison lamp patent is of little or no value, because it will not protect it. We do not quite see how any user anywhere can be punished for using lamps which a United States Court has declined to enjoin. Moreover, is it likely that the General Company will risk sustaining another such defeat? Two in succession would be absolutely fatal.

President Rhotehamel of the Columbia Company deserves much credit for his persistence. He was the under dog in the fight, and staked everything to protect the industry he had been developing in all good faith. We know that he tried to come to an understanding with the General Co., as would any honorable man; but they had no use for him and he therefore elected to fight. He has won, and to-day his factory is in full blast.

The situation is a curious one still, and likely to remain so. The lamp business has had great advertising lately and many new makers are likely to crowd into the field, which not long ago might easily have been restricted to a dozen concerns. The effect on all the new lamps of varying construction is also doubtful. It may yet be desirable to make them for their own sake; and it may not. As for Goebel, the old man must certainly feel repaid for many years of contempt and neglect. He is very much in the position once held by Asa Hapgood, toward to sleeping-car invention, and will probably never make any more than did that old inventor, who preceded Pullman and Wagner. It has seemed to us that there is very little doubt of Goebel's early, untimely and crude work. The man is not a great inventor and father of new arts like Edison, Elihu Thomson, Brush, Weston, Tesla, Graham Bell and Morse; but it will now take a great deal to disprove his claims. Judge Hallett holds that the burden of the case is on the complainants. In the meantime the art is virtually free. We think it will stay so.

THE CONDENSER IN ALTERNATING WORK.

UP to within a few years, the condenser had found its sole application in telegraphy and cable working, and the electrical engineer engaged in electric lighting and power transmission derived his sole knowledge of its properties from works on telegraphy. But the introduction of alternating motors has served to bring the condenser into prominence as a means for overcoming certain influences, and hence a discussion of this now important adjunct to alternating current apparatus, more especially motors, will be welcomed by a large class of our readers. With this object in view Mr. Wm. Stanley, one of the pioneers in alternating current work in this country, has prepared for the ENGINEER a series of articles devoted to the province of the condenser in alternating current work. In this series the author will show how the condenser operates to counteract the influences of self-induction and lag of current, and how by the introduction of capacity devices into the working circuits the excess of apparent energy over the real energy in watts supplied to an alternating motor can be provided for. The application of the action of the condenser in virtue of which the heavy false currents generated in alternating motors are confined to a local circuit must be considered one of the most important results reached in recent years. Its influence on the practical introduction of alternating motor work in increasing the efficiency of the apparatus and in the reduction of the copper otherwise required in the line will be the means of directing special study to its construction. Indeed the work already accomplished in the improvement of the condenser as a converter or rather transmitter of energy has already brought it up to a point of efficiency which leaves little if anything to be desired.

WORLD'S FAIR DEPARTMENT.

THE ELECTRIC FOUNTAINS AT THE WORLD'S FAIR.

BY

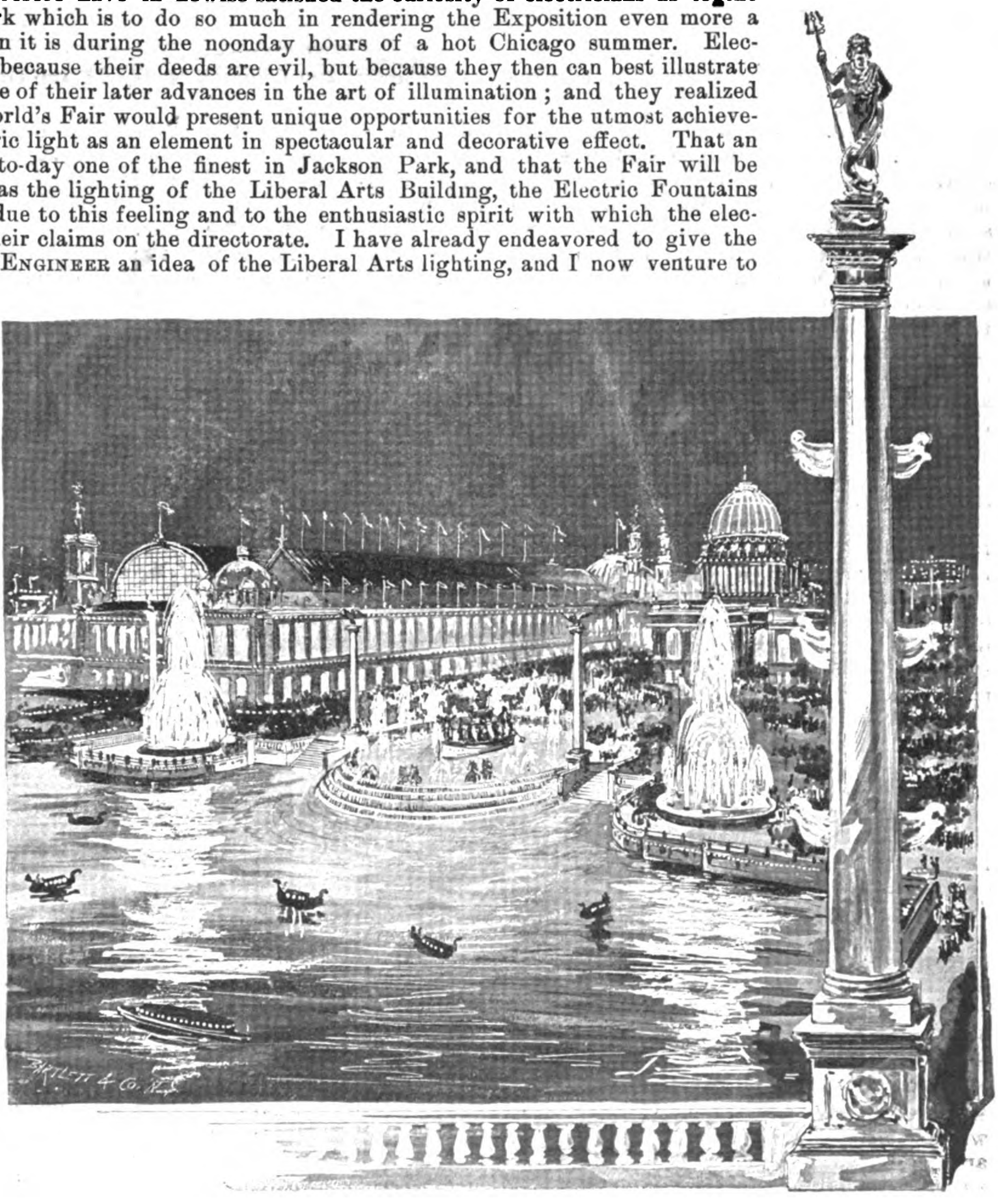
T. C. Martin

I.

While to the public the Stieringer electric fountains at the World's Fair will be attractive simply as a beautiful spectacle, of a kind and on a scale with which they are not familiar, to the electrical engineer they are interesting because of the problems involved in the work, and the manner in which they have been dealt with. The only articles that have hitherto appeared on the subject have been either popular or inaccurate, or both, and therefore have in nowise satisfied the curiosity of electricians as to the scope and nature of the work which is to do so much in rendering the Exposition even more a fairyland after nightfall than it is during the noonday hours of a hot Chicago summer. Electricians love darkness, not because their deeds are evil, but because they then can best illustrate some of the more remarkable of their later advances in the art of illumination; and they realized from the outset that the World's Fair would present unique opportunities for the utmost achievement in the use of the electric light as an element in spectacular and decorative effect. That an Electricity Building stands to-day one of the finest in Jackson Park, and that the Fair will be memorable for such things as the lighting of the Liberal Arts Building, the Electric Fountains and the Tower of Light, is due to this feeling and to the enthusiastic spirit with which the electricians of Chicago urged their claims on the directorate. I have already endeavored to give the readers of THE ELECTRICAL ENGINEER an idea of the Liberal Arts lighting, and I now venture to describe the electrical engineering features of the great Electric Fountains.

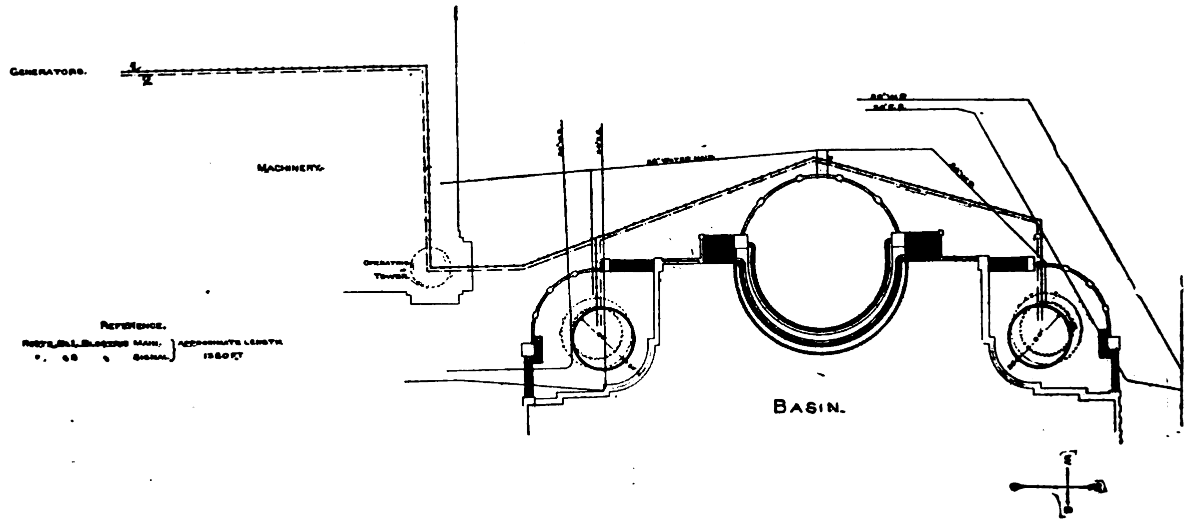
II.

Where the World's Fair could not be pre-eminent by originality or beauty, it was determined that it should still surpass by reason of its greater magnitude. It is to be feared that size is about all that can be claimed for some features of the show, as for some varieties of California fruit; but in respect to the Fountains a successful attempt has been made to combine all the elements of attractiveness. They front on the Grand Basin, with the stately Administration Building as a background, flanked by the rich palaces and bridges of Electricity, Machinery and Liberal Arts, and look out across the Grand Basin through the shafts of the Peristyle to the Lake. A better site could not be asked. Between the two fountains and occupying the central of a series of three bays with which the Administration Building plaza


BARTLETT & CO.

THE STIERINGER ELECTRIC FOUNTAINS, AT THE WORLD'S FAIR, CHICAGO.

comes down to the water's edge, is the magnificent MacMonnies "Columbian Allegory." High on a throne of state in a classic barge sits fair Columbia; the helm is in the hands of Father Time, and graceful virgins, typical of the arts and sciences, wield the long, broad-bladed sweeps. Just where the allegory comes in is not clear, although the ship is said to suggest the voyage of Columbus. It looks about as topheavy and unseaworthy as the "Santa Maria," and as it has neither sliding seats nor a screw propeller would probably travel half as fast as did she. But in spite of its being the first effort of a far inland Westerner at building a crack craft, the allegory poses charmingly between the two fountains proper, and when seen in their reflected light or under the beam of a search, will give the artistic effect which was probably all that its designer cared about. It is treated as a cascade, and only in part as a fountain. It is to rule the day, and the Electric Fountains are to rule the night.



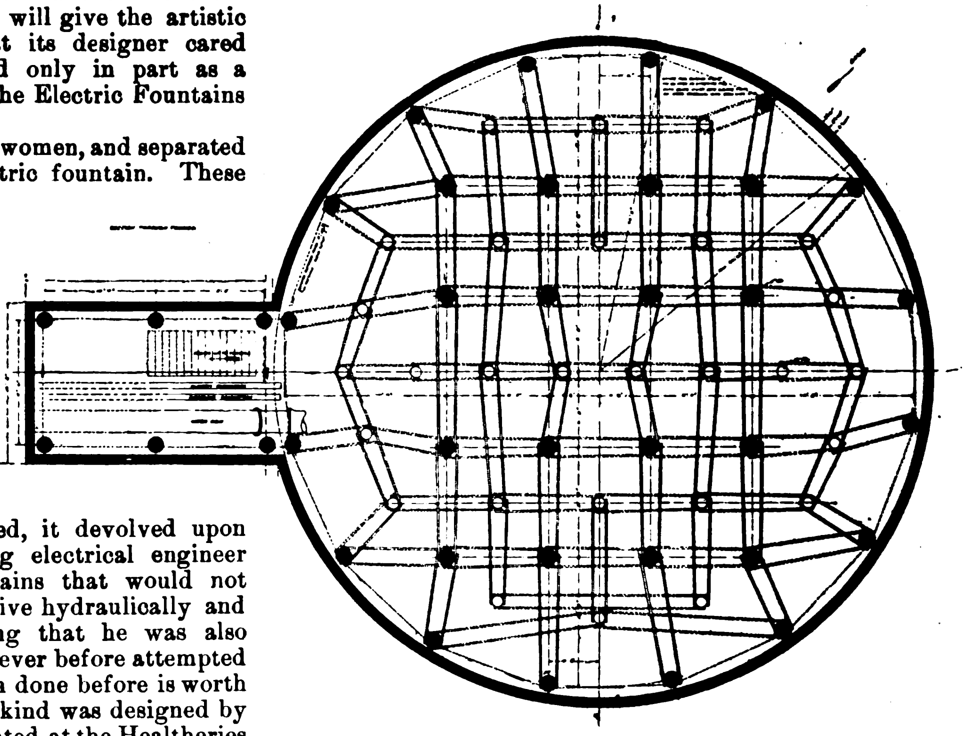
ROUTE OF FOUNTAIN ELECTRICAL CONDUCTORS AND LOCATION OF WATER AND OTHER MAINS.

Either side this boatful of fair oarswomen, and separated from it by flights of steps, is an electric fountain. These occupy sunken terraces, and each fountain stands within a basin 60 feet in diameter. One can descend into the bays by steps or overlook them from the plaza balustrading. The best point of view, is, of course, in front, across the Basin, or from the sides at a long angle.

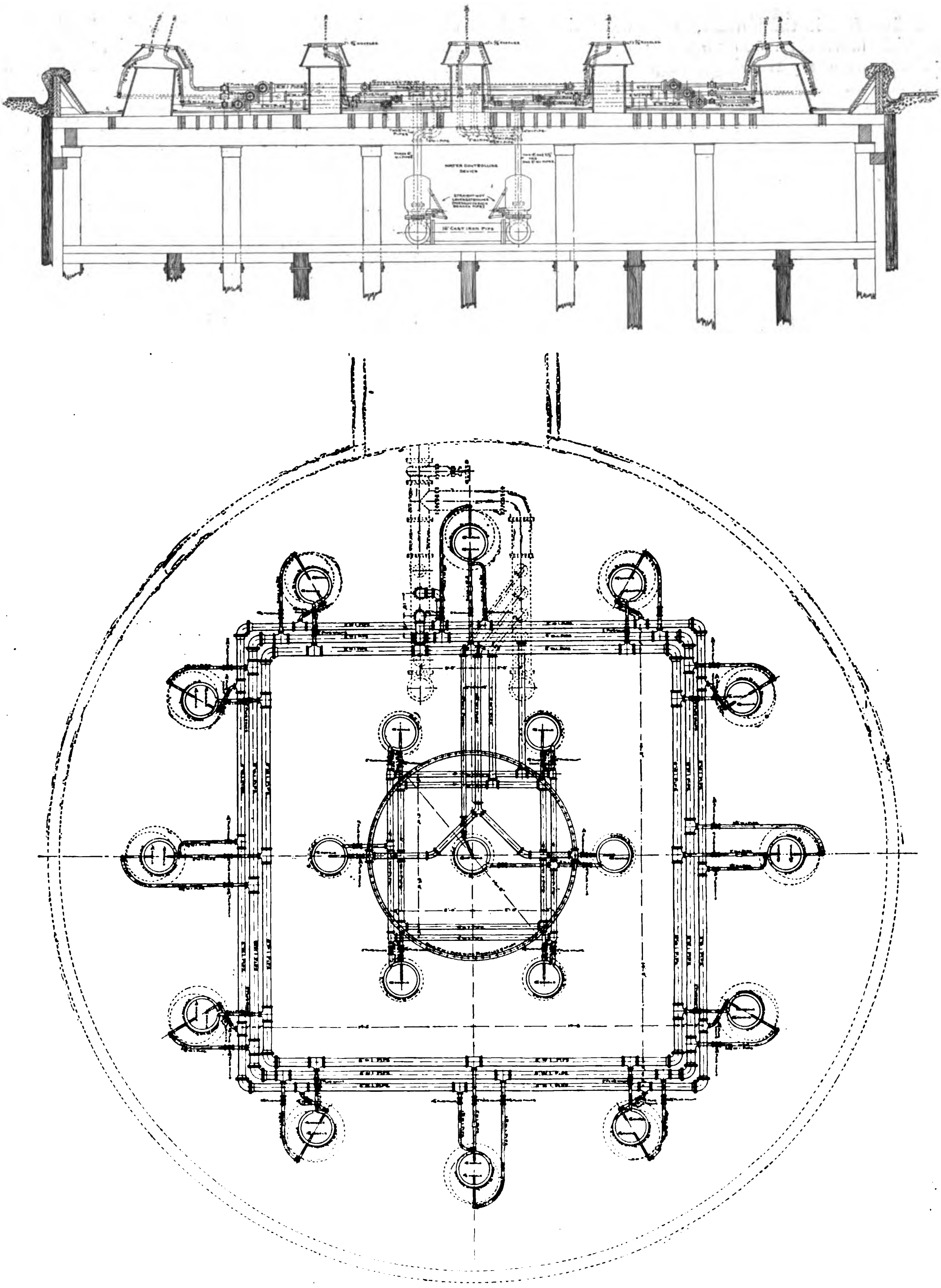
III.

On these two Fountains all the electrical work is concentrated, and the location having been settled, it devolved upon Mr. Luther Stieringer, the consulting electrical engineer of the Exposition, to devise fountains that would not only be beautiful, but easily operative hydraulically and electrically. It goes without saying that he was also expected to transcend everything else ever before attempted in this direction. Just what had been done before is worth noting. The first fountain of the kind was designed by Sir Francis Bolton in 1884, and operated at the Healtheries Exhibition in London. An island was constructed in the middle of the piece of ornamental water, under the principal group of jets and constituting a habitable chamber, with watertight glass windows in its roof. Inside each window was a holophote with lens, and an arc lamp, so arranged that the light was thrown upward upon the water and spray as it emerged from the jet. Combined with the water display from the jets was a cascade, and a spray curtain, while in combination with the island lights were projectors placed on adjacent towers and sending thence their beams over the waters. Controlling the whole was an electric signaling apparatus with a complicated keyboard of 36 pushes, by means of which the commanding officer at a convenient point could direct the changes that were to be made by his assistants in the island and on the towers. Color effects were obtained by interposing sheets of colored glass or gelatine in front of the lenses in the path of the beam.

There was thus evolved a luminous fountain having a submerged operating chamber of smaller diameter than the basin in which the falling water was received. This type of fountain was introduced in America, on Staten Island, and was then taken to Lincoln Park, Chicago, where it is still in operation. In Europe, it was employed at later London exhibitions and at Glasgow, and was then adopted in a somewhat similar form for the Paris Exposition of 1889. But it was found undesirable to utilize the same



PILING AND STRUCTURE OF SUBMERGED CHAMBER.

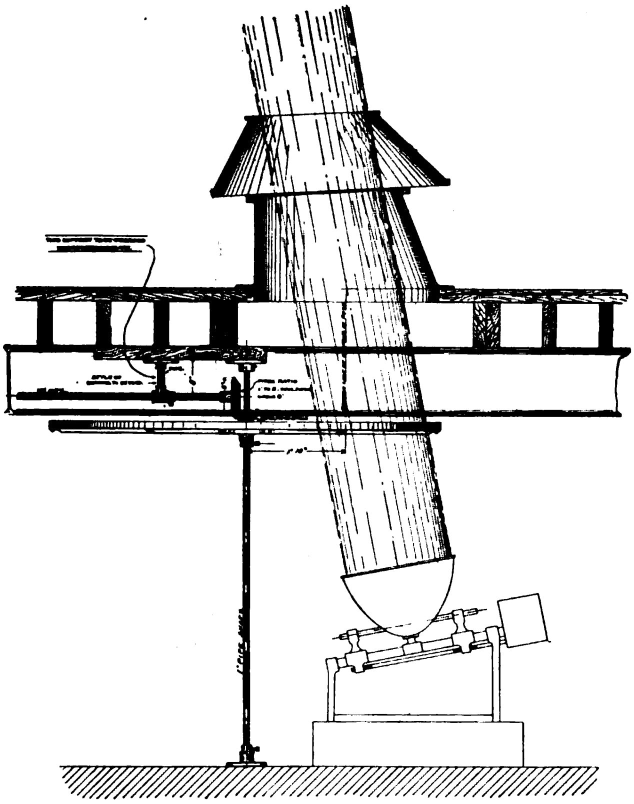

WATER CONTROLLING DEVICE
STRAIGHTWAY LEVER GATE VALVES (ONE VALVE TO EACH BRANCH PIPE)
15" CAST IRON PIPE

Electric Fountains, World's Fair, Chicago—Plan and Section of Piping for Water Distribution.

methods for the World's Fair, and Mr. Stieringer has developed a new type capable of yielding better results at a marked economy over the expense that would have been necessary with what are known as the Bolton and Galloway plans. The only thing in common is the use of a submerged chamber. An effort made to secure these fountains from abroad was a failure, the price being prohibitive and the methods too cumbrous to win American approval.

IV.

The ground on which the Fountains are situated was the shifty sand dunes of the Lake shore and needed special treatment. It was necessary to excavate in the swamp and there sink a watertight chamber, eight or nine feet below water level. The plan proposed by engineers and warmly advocated was to sink an iron tank 60 feet in diameter. But a little study showed that this would require a trussing of four or five feet in the bottom, and a weighting of the structure with more than 500 tons of iron. There would also have been necessary trussing on top to sustain the roof and basin, with all the piping and three feet of water; thus forming a clumsy coffer dam and caisson arrangement. To say nothing of the cost, the difficulties due to lack of time were prohibitive. A simpler plan was needed, and taking advantage of the ideas employed by General Fitzsimmons, the well-known caisson and tunnel builder of Chicago, for like emergencies, Mr. Stieringer devised the plan set forth in the accompanying illustrations. Page 428 shows the plan of either fountain bay, both being the same; and a plan of the piling. It will be noticed, page 429, that the piles are of varying length, the longer supporting the roof of the basin, appearing in the chamber like columns. The shorter piles are covered with an interlacing of timber which is concreted and forms the bottom of the chamber. The framing of the structure is such that the pressure from below and from the exterior is equally distributed. It is faced outside with Wakefield sheet piling in three layers, 3 inches thick by 12 in width, 20 feet in length, and lap-jointed. This was all sand-jetted in. A suitable sump is provided for any drainage or infiltration. At one side of the drawing is shown an entrance, similarly constructed and similarly watertight. This provides not only for purposes of approach, but for the piping, electrical apparatus, etc. Ventilation is also carefully attended to. It deserves mention that Mr. Stieringer does not consider the fountain basins quite large enough, and that it would have been better to elevate the fountain beds in the shape of rockeries. The idea was given up simply on the ground that such rusticity would not blend with the architectural surroundings. Mr. Stieringer therefore abandoned reluctantly the true geyser effect aimed at.



Vertical View Showing Outside Jet Color Screen and Gear.

V.

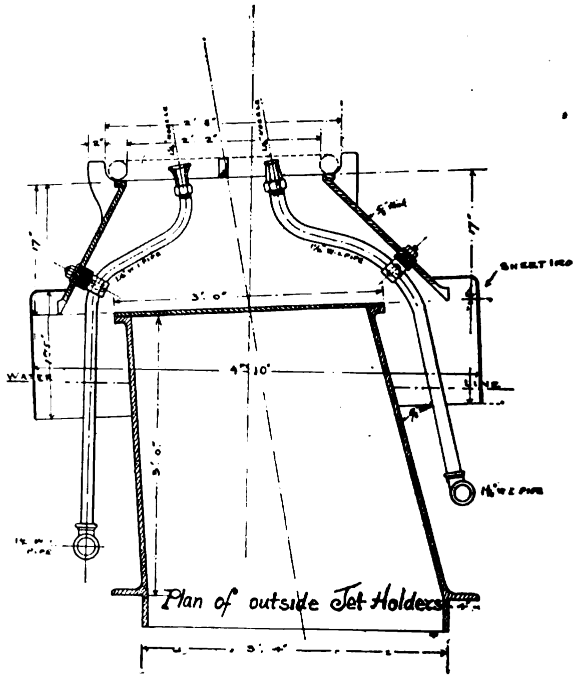
We come now to the lighting and the supply of water. It has already been stated that the MacMonnies allegory is treated rather as a cascade than as a fountain. It has no electrical illumination of its own, and while supplied liberally with water by a 36-inch main, the flow is chiefly in the form of a cascade, down half a dozen steps from the rim of the basin in which the barge floats.

To each of the Electric Fountains runs a 24-inch main carrying water at 100 pounds pressure. The total consumption is at the rate of 20,829,600 gallons per 24 hours. The group represent all the capacity of the 40 million gallon Worthington pumping station in Machinery Hall.

Each fountain comprises the following:

12 Wheatsheaf rings containing 1,560 ⅛ inch holes.
7 Little Geyser rings containing 49 ⅝ inch holes.
1 Curtain ring containing 70 ¼ inch holes.
18 Nozzles, 1¼ inch, for small geysers and parabolas.
12 Nozzles, 1½ inch, called "pulverizers," on the outer edge.
1 Nozzle, 2 inch, called "Great Geyser."

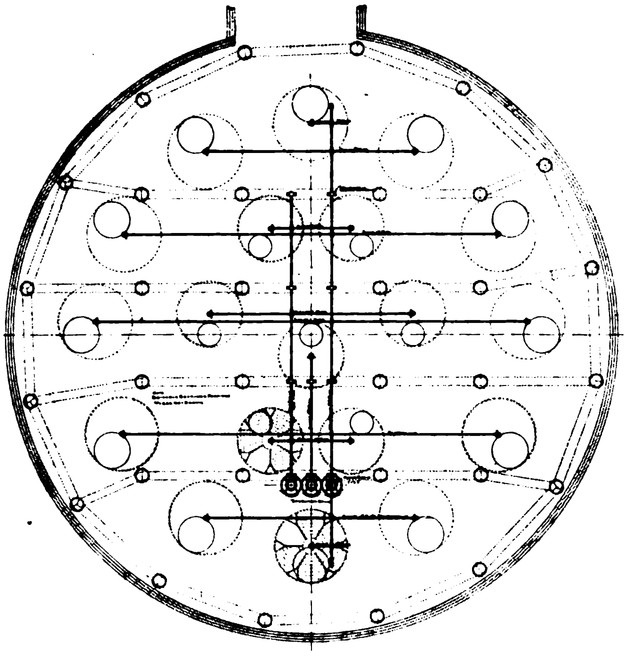
These are all shown on page 429. It will be evident that this arrangement and this quantity of water, under such pressure, furnishes a beautiful fountain for day time display. But it will also be seen that geysers, wheatsheaves and parabolas provide for the use of the electric light at the points of greatest value and efficiency. According to Mr. Stieringer, the beauty of an electric luminous fountain depends upon the realization of the volcanic effect, well illustrated by the flames bursting from a Bessemer converter; and it is this he has aimed at. The waters will well up and leap skyward like streams and masses of vari-colored lava, and the pools will seethe as though they were molten metal. At the centre of each fountain is the Great Geyser, encircled by a ring of jets called the curtain, and flanked at six points by the Little Geysers. On the next and outermost circle of all are the parabolas and "pulverizers," combined with the central wheatsheaves. There are in all 19 composite groups in each basin. The nozzles are all concealed from view, being masked by bronze water plants. When working at the maximum, the central jet, or Grand Geyser, will throw its two inch stream of water nearly 150 feet up into the air.



Jet Holder For Electric Fountains.

VI.

To light each of these fountains, 19 arc lamps of 80 to 90 amperes are placed in each caisson or operating chamber, specially constructed for the work, and embodying many new ideas. Near the entrance to each chamber is placed

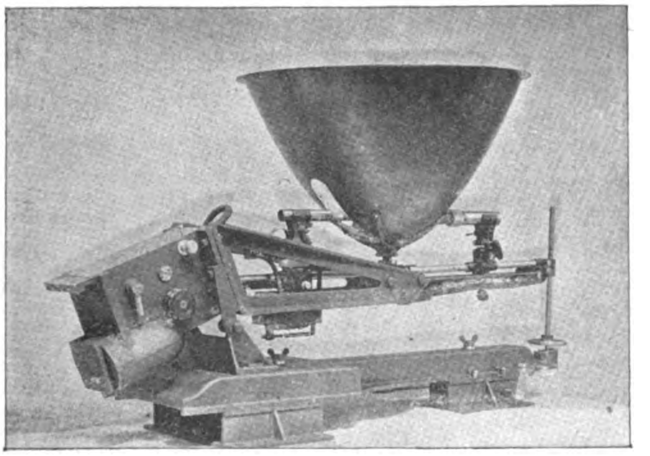


Shafting and Gearing For Color Screens.

the switchboard, to which is brought current, on the 3-wire system at a potential of 240 volts. The lamps and board have been very carefully and cleverly designed by Mr. E. R. Knowles, the electrical engineer of the Schuyler Electric Co. To furnish current for the lamps two direct connected General Electric generators are installed in the service plant in Machinery Hall, and the circuits are run to the fountains by means of the Edison iron tubing of the type familiar in city incandescent lighting work.

It should be stated that the lamps are estimated to give a beam of light of 250,000 c. p. each. The lamps are run two in series, and are automatic in their action, being provided with electrical apparatus for striking their arc, and automatically feeding their carbons together as they are consumed, so as to keep the arc central to the reflector. The beam is either vertical or at a slight angle to the vertical. The silvered reflector is 28 inches diameter.

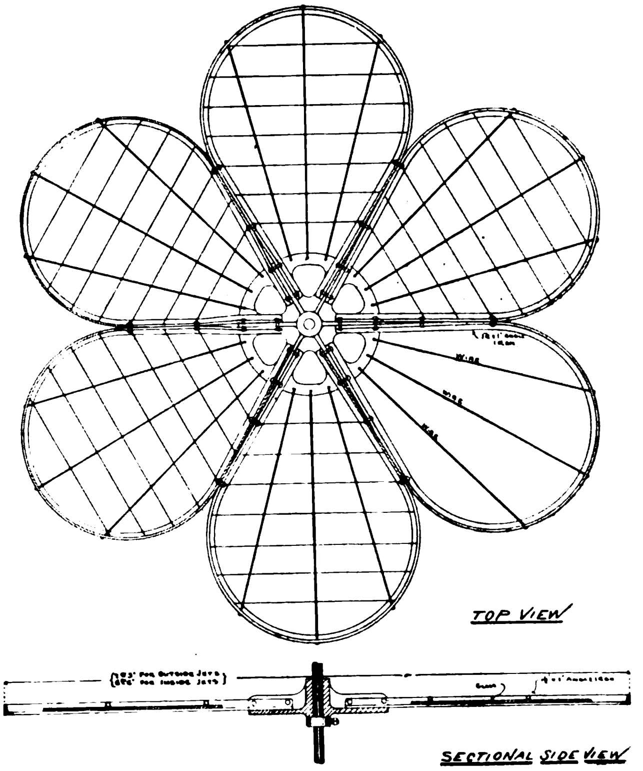
The switchboard, p. 432, is, as already stated, on the three-wire system, and is provided with voltmeter and ammeter, so arranged that the voltage on either side of the system and the current flowing in any lamp circuit can be measured by them. The switchboard also carries at the bottom a rheostat for each lamp circuit by means of which the current flowing in the lamp circuit can be regulated. There are also switches for throwing the lamp circuits on and off, and at the back of the board are grouped fuse boxes for safety.



Projector For The Electric Fountains.

The valve mechanism is also concentrated at the switchboards in each fountain, and hence it is easy for one or two men to manipulate switches, valves and revolving color screens. The chambers are high enough to enable the attendants to move around easily and in an upright position.

In connection with these arc lights, each of which acts as a holophote at the centre of and under each of the 19 composite groups of jets is Mr. Stieringer's very ingenious system of color screens, operating in a horizontal plane, as illustrated on this page. It will be remembered that in the Bolton fountains the colored screens were laboriously slid in and out like lantern slides. In this instance, the screens are so geared together that they can all be operated easily by a single attendant, and at a high rate of speed.



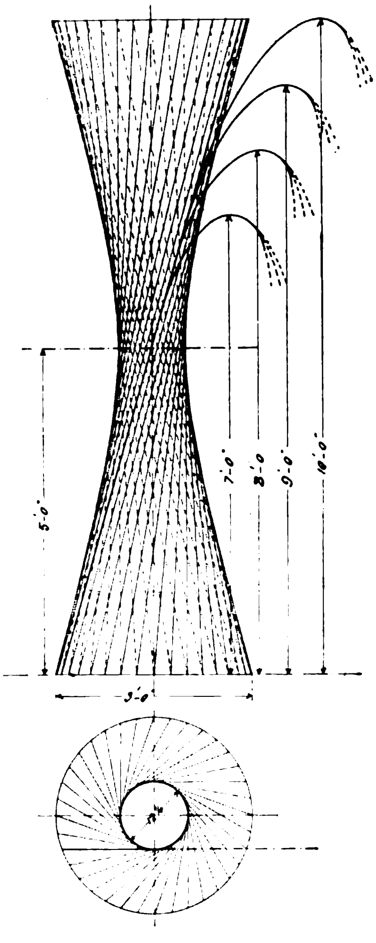
Detail of Color Screens.

The screens are mounted at the top of standards, and resemble a Japanese umbrella stood on end. As the screen revolves each of the colored blades or paddles comes in the range of the beam of light from the arc lamp reflector. There are six blades—sea-green, green, yellow, blue, ruby and plain white; and the groups are arranged so that they can be run in any kind of combination. The glass in each screen is divided into sections, to obviate the trouble that might be caused should any arm of these glass windmill sails remain long subjected to the heat of the arc. The vanes are supported by pipe shafts, and the arc lights are carried on standards or bases placed on the floor of the caisson. The pipes to many of the jets curve so as to bring their streams directly into the light from the holophotes, and the valves and switches are so grouped that the play of the streams and the burning of the arc lights is controllable at will.

For the purpose of operation and control, there is an operating station in Machinery Hall on the North-east corner tower, from which point all signals will be given to both fountains. The director from this point of vantage

will give all orders, and telephonic communication will supplement at each instant the code of signals devised beforehand. Additional to the lights in the two Electric Fountains, will be search lights placed on various buildings adjacent, and from time to time their beams will be directed athwart the scene, and more particularly upon the MacMonnies group in the centre of the picture. In this manner an effect will be produced that none who see it are likely to forget.

A view shown below from a photograph taken at the Schuyler factory before shipment, is given of the signaling board or table by means of which the orders are conveyed from the Machinery Hall tower to the fountains. It will be seen that everything is compact, the apparatus being so grouped as to respond instantaneously. The numbered boxes show when any jet is in operation, and the light that burns while it is playing shines through glass of the color corresponding to that on the fountains. The fact that the number of conductors is in excess of a hundred will give an idea of the great variety of changes and combinations possible. The valve signal box is similar to that used in naval signaling, with the code on the circular dial, numbered from 1 to 50 consecutively.

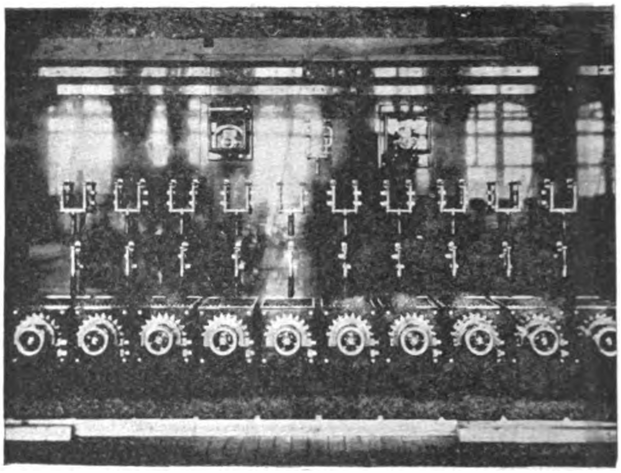


Jet Arrangement For Outside Wheatsheaf.

In the fountains, at the regulating boards, are annunciator boxes for the screens and valves, so arranged that the color annunciator shows at any instant by colored drops the complete combination to be used at that time; and the valve annunciator shows by figures the complete combination of valves to be operated.

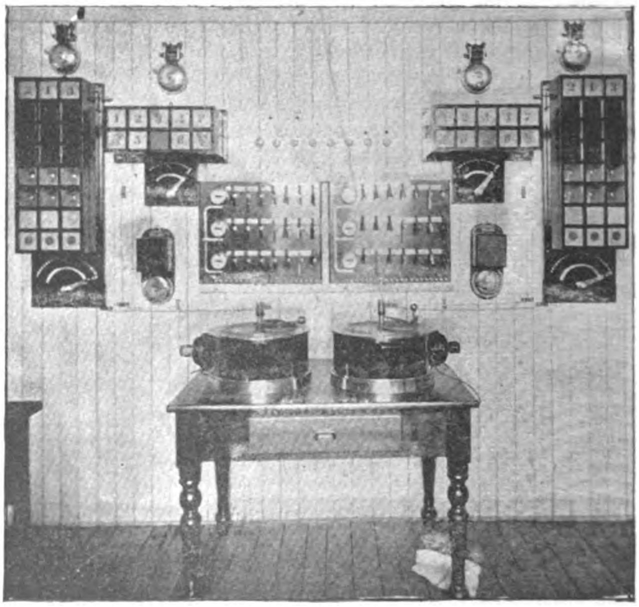
VII.

These electric fountains will have a greater number of water orifices, a greater number of electric lights, a greater volume of water and a greater variety of illuminative and kaleidoscopic effects, than have been presented anywhere before in work of this nature. This, perhaps, is something, though more to be admired is the ingenuity which has reduced the mechanism, attendance and expense, to the lowest possible limits. Mr. Stieringer says that an electric motor with a small commutating device might fairly well take the place of the director any night, without the slightest suspicion on the part of the huge crowd that the beautiful changes going on beneath their eyes were due merely to an automaton. As it is, a number of cumbrous and intricate devices have been dispensed with, and the watchful agency of one or two men will accomplish everything.



Caisson Switchboard For Operating Each Fountain.

A word or two is in place as to the quantity of electric light employed for the World's Fair fountains, as compared with the amount utilized in preceding cases. In these fountains there are 38 arcs of no less than 90 amperes each,—many times the quantity of current used in the ordinary 2,000 c. p. arc light. The first Bolton fountains appear to have had about a score of ordinary arc lights and a couple of hundred incandescents. At Paris, in 1889, on



Valve Signal Boxes.

Signalling and Control Apparatus in Machinery Hall Tower.

the two groups of fountains there were concentrated 17 arcs of 60 amperes each and 30 of 40 amperes each. But while the holophotes will be more powerful at Chicago, as shown by these figures, the search lights will also be more intense and effective.

The question may be asked: How long will these Fountain displays last? This depends of course on circumstances, but it may be safely said that the exhibitions should not last more than 8 or 10 minutes at a time,—if as long. They will continue through the evening, but no one can enjoy such a spectacle kept up continuously. A thrill that lasts half an hour without an intermittent throb or pause would probably become overwhelming; and these stupendous spectacular effects are in the nature of sensations or thrills. They must not have deferred finales. The Paris Fountains of 1889 lasted 4 minutes at a time, and were played hourly.

VIII.

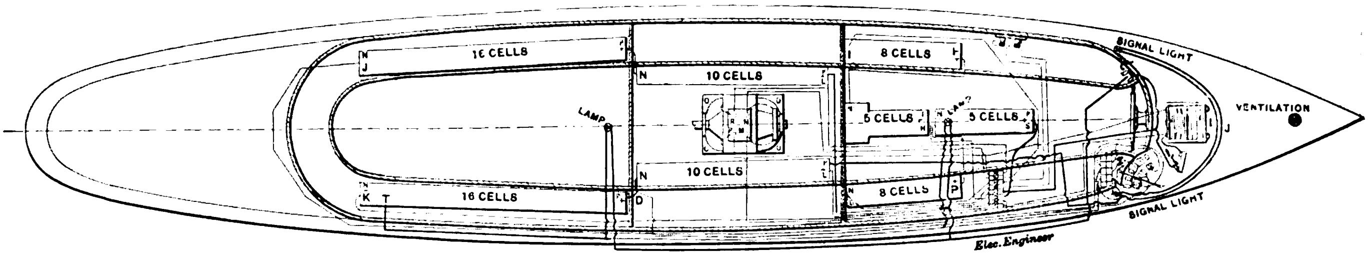
It is needless to say that a great many persons co-operated to make the Electric Fountains possible. Some of them have already been mentioned. Director of Works Burnham showed great personal interest in the work from the start, and to him is largely due the realization of Mr. Stieringer's bold plans, as in the case of the Liberal Arts Building illumination. Nor should Mr. F. Sargent, the mechanical and electrical engineer, be forgotten for his painstaking support. At first there was a variety of opinion as to the proper location of the fountains, and the artists consulted wanted at one time to relegate them to any place but the Grand Basin, for fear of contrasting with the MacMonnies fountain. This Mr. Stieringer strenuously opposed, and he found a warm ally in Mr. MacMonnies, who saw at once how brilliantly the fountains would set off his allegorical masterpiece and put it in evidence after dark. On the part of the General Electric Company, contractor of all the work, Lieut. E. J. Spencer, special agent in charge of their exhibit, had the construction and installation of the electrical apparatus under his supervision. These fountains may fairly be called a General Electric exhibit. The mechanical work has been done by the Bouton Foundry Company, of Chicago, and the hydraulical work by the John Davis Company.

I am indebted to the firms and persons named for much useful data; to Mr. Stieringer for access to his original designs; to Mr. E. R. Knowles of the Schuyler Electric Company for photographs of lamps, switchboards, etc., and to Bartlett & Co. of this city for the fine illustration intended to give an idea of the White City in a burst of subterranean moonlight.

N. E. L. A. At an executive committee meeting in New York of the National Electric Light Association, President Armstrong in the chair, it was decided in view of the World's Fair, and the Electrical Congress in August, not to hold a summer convention this year, as members will either attend the Congress or go to the Fair at the time most suitable to them.

ELECTRIC LAUNCHES AT THE EXPOSITION.

A NOVEL means of transportation, and one that will prove a most attractive feature of the World's Columbian Exposition at Chicago, this summer, will be the fleet of 50 electric launches, which will make regular trips over a course of about three miles on the lagoons and other interior waters at Jackson Park. The plan of water connection was first conceived by Mr. Frederick Law Olmsted, the landscape architect of the Exposition, and General C. H. Barney, of New York, is undoubtedly the originator of the scheme to employ electric passenger launches. These boats are to run from 8 a. m. until the Fair closes at night, and the landings on the course will enable passengers to get on or off at any of the buildings and principal points of interest; thus rendering the launch fleet the best means of communication between different parts of the grounds, as well as the most delightful method of obtaining a general view of the magnificent buildings, which all front on the lagoons and canals.



PLAN OF WIRING, WORLD'S FAIR ELECTRIC LAUNCHES.

As may be supposed, the competition for this valuable concession was very great. Several concerns were bidders for this exclusive privilege, and each of them was required to build a sample boat to be submitted to trial tests during the months of June and July last, to determine which class of craft was best suited to fulfill the requirements of passenger traffic on the Exposition waterways. Steam, naphtha and electric launches were tested, with the result of success for the electric boat "Electra," owned by the Electric Launch and Navigation Company, of New York, which concern was thereupon awarded the franchise. (This beautiful craft has already been illustrated in THE ELECTRICAL ENGINEER.)

The general dimensions of the boats to be used will be 35 feet, 10 inches in length, over all, with a beam of 6 feet 3 inches, and a draft of 28 inches; they will seat comfortably about 30 passengers each. The motive power will be furnished by storage batteries, manufactured by the Consolidated Electric Storage Company, and motors especially designed and constructed by the General Electric Company. Batteries and motor are placed beneath the seats and flooring, so that the utmost carrying capacity of the boats can be availed of; and they are absolutely free from smoke, grease, offensive odors and vibration.

Each boat in actual operation during the Fair will cover on an average 40 miles a day, with one charge. The total mileage per day for the 51 launches will therefore aggregate 2,000 miles, or more than from New York to Chicago and back each day. The normal speed, all that is allowed by the World's Fair, is six miles per hour. A speed of eight miles per hour is, however, at the control of the pilot for emergencies.

The batteries used for supplying current to the motor are the latest and most improved form of the well-known Consolidated Electric Storage Company. The 4 h. p. motor that is directly connected with the propeller shaft was especially designed by the General Electric Company for this purpose and has shown itself efficient and durable. The controller consists of magnetically controlled switches operated by a lever at the pilot's right hand. Four speeds ahead and two astern are found to answer satisfactorily all purposes. Should any batteries be injured by an accident they can be replaced in less than five minutes.

The accompanying diagram shows the arrangement of the batteries and the plan of wiring adopted. For the regular and moderate speeds required the batteries are first grouped in three divisions of 26 cells in series, giving a pressure of 52 volts and a total discharge of 42 to 45 amperes, or 14 to 15 amperes per cell. This grouping operates with, and without, a resistance in circuit, according as the pilot manipulates the lever. The other grouping consists in putting the 78 cells in each launch in two groups of 39 cells in series, giving a pressure of 78 volts and a discharge through the motor of about 55 amperes. This grouping also operates with, and without, a resistance. This method of grouping is used to prevent over-discharging from the batteries and to give a steady and continuous current to the motor.

When a launch returns to its dock at the charging station from its 40 mile run, it is thrown on charging in less than one minute by an independent switchboard connected to feeders from large General Electric Company dynamos in Machinery Hall. For the 10 to 12 hours run a charge of 5 to 7 hours at an average rate of 15 amperes will ordinarily recharge the batteries.

The course to be taken by the launches will be from the north side of the Agricultural Building, along the south side of the Manufactures Building, thence up the North Canal through the East Lagoon, turning into the north inlet, past the Fisheries Building to the Clam-Bake Landing. Thence, back again through the inlet, and into the North Lagoon, to the Fine Arts Building. From there, returning, and down the West Lagoon and North Canal to the starting point.

The round trip will occupy about 52 minutes, and the fare for the same will be 50 cents.

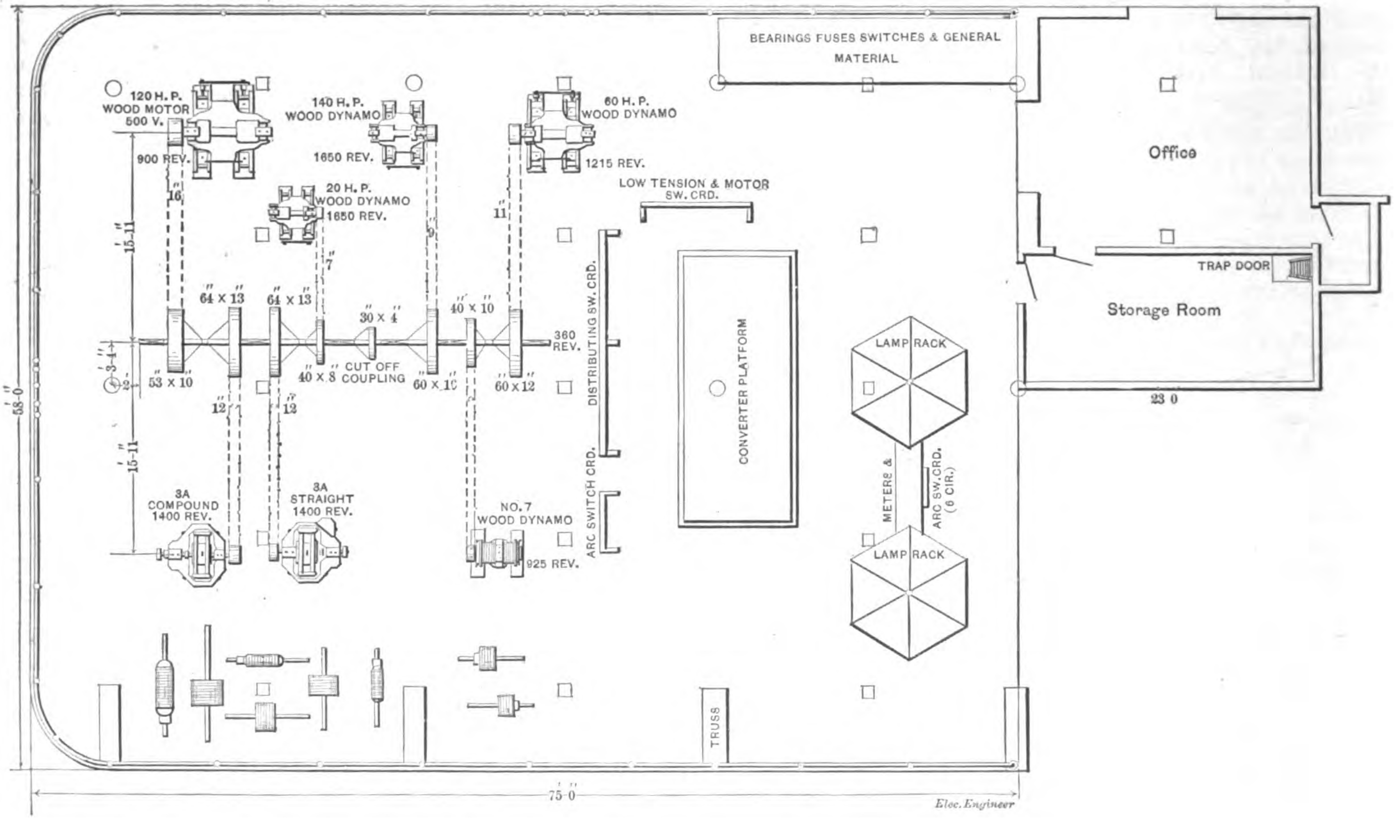
The boats will be carpeted with perforated rubber mats, with a solid canvas backing to catch all dirt and water. The awnings and side curtains are striped orange and black. The boat shed and charging station will occupy the east and south sides of Agricultural Annex, some 700 feet in all. The officers in immediate charge of the operation of the concession on the grounds are: General Manager, C. D. Wyman; superintendent, C. H. Barney; electrical engineer, R. N. Chamberlain.

For the use of its principal officials, the Exposition has purchased four of these boats, similar to the above, but with decks and interior more highly finished and with different colored awnings.

THE EXHIBIT AND SPECIAL LIGHTING OF THE FORT WAYNE ELECTRIC COMPANY.

The lighting of the Electricity Building will be effected by arc lamps on every truss on the lower floor and on each alternate truss in the balcony, besides the "Tower of Light," and the lamps forming parts of the various exhibits, and will be operated by the General Electric, Brush, Western Electric and Fort Wayne companies, and the German Government. Of these the Fort Wayne Electric Company are the first in the field and they have already strung a large proportion of the wires necessary to perform their part of the work. All the wiring is inclosed in Interior Conduit tubes placed along the truss diagonals so as to be invisible from below, but perfectly easy of access from above.

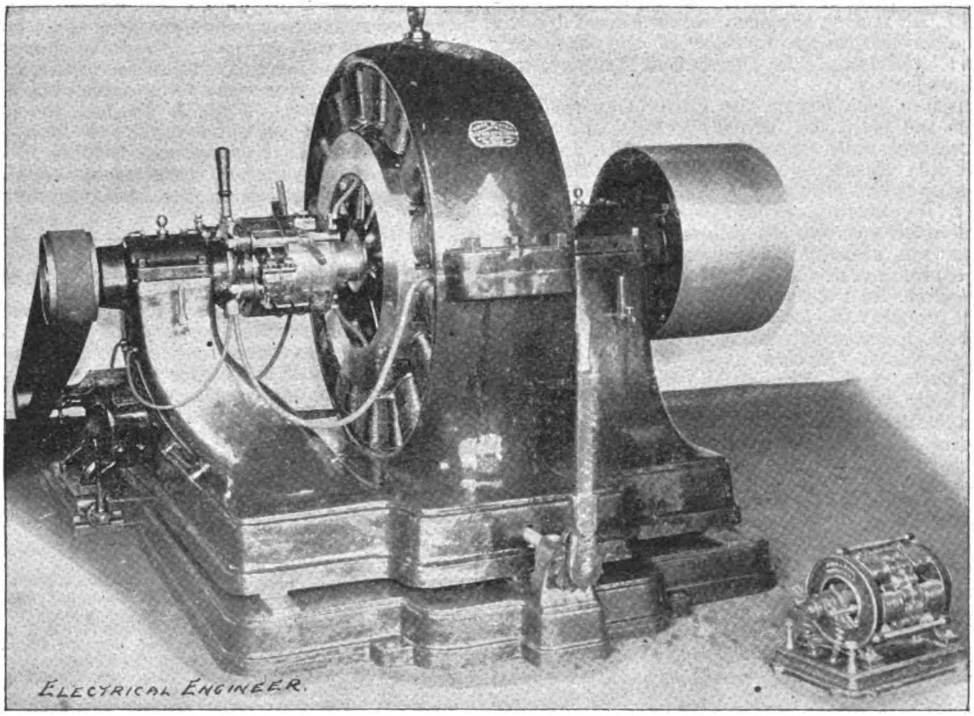
The space lighted by the Fort Wayne Electric Company comprises about one third of the gallery, including the section to be occupied by THE ELECTRICAL ENGINEER, and the system of wiring employed is worthy of especial mention. In this space 78 arc lamps are placed on the trusses and on ornamental pillars, alternate lamps being connected with independent circuits, so that, in case of accident to one entire circuit, the light over the whole area would only be decreased about one half, and no one spot would be left in comparative darkness. This arrangement is due to Mr. E. A. Barnes, the electrical engineer in charge of the Fort Wayne Company's exhibit, to whom is due the advanced state and workmanlike appearance of the installation.



Plan of Fort Wayne Exhibit, World's Fair, All Driven by Electric Motors.

The accompanying diagram, page 434, shows the Fort Wayne exhibit proper, in plan. Here will be shown the first arc machine designed by Mr. J. J. Wood, driven by his first motor, and side by side with this the new Wood iron-clad alternator, remarkable for the beauty and originality of its design and its absolute freedom from noise when running. On an ornamental rack, facing the main aisle will be 60 arc lamps controlled by switches to show the regulation and economy of the Wood machines. There will be 26 kinds of lamps on the test rack, among them two new types recently invented by Mr. Wood; a low-tension lamp for any incandescent circuit and a noiseless alternating lamp designed for a 50-volt circuit. The figures as to the new alternator are :—

K. W.	Capacity.	Speed.	Diameter.	Face.	Belt.
37.5	750 lts.	1400	14 in.	8 in.	7 in.
75.	1500 lts.	1050	18 in.	14 in.	13 in.
150.	3000 lts.	700	28 in.	26 in.	24 in.
300.	6000 lts.	467	40 in.	50 in.	48 in.



MR. J. J. WOOD'S FIRST DYNAMO AND HIS LATEST ALTERNATOR, WORLD'S FAIR.

The transformers are all placed on an insulating fireproof base directly adjacent to the source of power, and from these current is distributed. Thus any customer can be accommodated with any kind of current he may wish at any moment; direct, alternating, high or low-tension or sometimes one and sometimes another, if he so desire.

Beyond the switchboard are the office and storeroom; the former furnished and lighted as a reception-room, and showing various styles of fixtures.

The Fort Wayne Electric Co. is the only one, we believe, whose entire plant is situated within the Electricity Building. Three generators in Machinery Hall will supply current to two motors belted directly to a four-inch line shaft which in turn drives all the generators. The pulleys are all provided with friction clutches, as shown in the plan, so that the whole plant is as flexible as possible. An interesting feature of this exhibit is that everything in it is "practicable." All the generators, motors, lamps, transformers, etc., are shown in actual operation, and just enough of each style is introduced to give the sight-seer an adequate idea of the work of the company.

ADDITIONAL ELECTRIC RAILWAY FACILITIES FOR THE FAIR.

ON and after the first of May, the street railway lines on Thirty-fifth, Forty-seventh, Sixty-first and Sixty-third streets, now using horses, will be operated by electricity, and the system will probably be still further extended later on. The four lines mentioned include about 13 miles of double track and are the natural World's Fair feeders for the South Side. Some of these cars will run through the Midway Plaisance while the rest will go to the loop at the main entrance of Jackson Park. There are now on hand, and waiting in the car house, 61 cars equipped with Westinghouse single reduction motors.

The power house, situated at Fifty-second and State streets, is built of iron, brick and stone, 125 by 137 feet in plan and has sufficient room for 10 engines and generators for operating 150 miles of road. Four 700 h. p. Westinghouse generators will be sufficient for all present needs, it is thought, and these are already in place and ready to start. They will be run at 300 revolutions by means of a cotton rope driven from two 500 h. p. engines each.

The outside construction is neat and substantial in appearance. The poles are of cedar, 35 feet high, except at Forty-seventh street and Grand Boulevard and where the road skirts the Fair grounds on Stony Island avenue. Here they are of latticed iron, light and graceful in appearance.

A thorough test was made on April 27, and the road is now ready for duty.

RAILWAY EQUIPMENT COMPANY AT THE FAIR.

THE following circular relative to the World's Fair has been issued by Mr. W. R. Mason, the general manager of the Railway Equipment Company :

> Assuming that it is your intention to visit the World's Columbian Exposition, and realizing that you will be pleased while here to meet others interested in the operation of street railways, we have thought it might be a convenience for us to open a directory of visitors to the Fair.
>
> As it will probably be also a convenience for you to meet your friends at a central and accessible point, we would be pleased to have you send to us the names of those of your Company who expect to be in Chicago at that time, giving also the date of arrival, and, if possible, the hotel or apartments where you may be found. As soon after arrival as convenient, we would suggest that you call and register at our office, which is in perhaps the most convenient and prominent location in the city.
>
> Our office is directly opposite the new Art Gallery, where the World's Fair Congresses will be held, and is almost directly opposite the main depot for World's Fair trains. We shall certainly take pleasure in extending every courtesy to our friends during the six months, and we trust you will make our office your headquarters, and, if desired, have your mail addressed in our care. In the meantime, we shall be pleased to furnish any information needed, as well as to attend to any matters connected with your visit to the Fair.

GENERAL ELECTRIC AT THE WORLD'S FAIR.

APPLICATION for space at the Columbian Exposition was first made a little over a year ago by the Edison General Electric Company and the Thomson-Houston Company, prior to their consolidation, and each company naturally sought to secure the best possible positions in the Electricity Building. Since the two have been made one,—and have laid down inside each other—it has been found necessary to re-apportion the space, several intending exhibitors having given up the idea of making any display, and the consequence is that the General Electric Company have been so fortunate as to secure the most prominent and important space in the entire building. They now occupy the five central spaces in the heart of the building; the circular space directly beneath the central span and the four adjacent ones radiating from it. The "hub" of this great wheel, 34 feet in diameter, is occupied by the "tower of light," a graceful shaft covered with thousands of incandescent lamps, which will be by far the most striking feature of the entire electrical exhibition.

From one door to the other across the building and the whole width of the transept, the same company holds sway, as well as in the adjoining spaces under the galleries, and for a considerable distance in each direction on the main isle. The entire area comprises over one-fourth of the ground floor of the building, and about one-seventh of the whole available space.

In addition to this and aside from the regular exhibits, the company has acquired contracts for a large amount of arc lighting and motor service, for storing the accumulators used by the launches, for the entire electric equipment of the stationary battle ship "Illinois;" for that of the Intramural Railway, and for the search-light projectors.

When the Exposition was begun, the Edison General Electric Company put in the plant for furnishing light and power temporarily to the various buildings and the grounds, and this temporary plant has only within the last few days been removed. From a small beginning it had grown by the latter part of 1891 to such importance as to require four arc and two low tension incandescent lighting generators and two 100 kilowatt 500 volt power machines. This plant has steadily continued to perform satisfactory duty under all manner of disadvantageous circumstances, running at far more than its rated capacity in a leaky frame structure situated in probably the lowest and dampest part of the grounds. It has thus operated several months longer than the original plans contemplated. Motors have been operated in numbers in various parts of the grounds and buildings for elevators, mill, and all manner of machinery work, and as a mark of appreciation, the Exposition has awarded the company the right to furnish all motors for service during 1893, from one to 100 kilowatt capacity.

The arc lights for service on the grounds and in the buildings installed and operated by the company will amount to about 3,500 of 2,000 candle power each. In the Manufactures and Liberal Arts Building the Thomson-Houston system is used in accordance with plans specially drawn by the General Electric Company. A comprehensive article on the lighting of this building, it will be remembered, appeared in THE ELECTRICAL ENGINEER of March 29.

The two electric fountains in front of the Administration Building at the end of the basin, one on either side of the exquisite piece of sculpture known as the MacMonnies fountain, far exceed in mechanical and electrical detail, anything of the kind on either continent. Their water supply is obtained from the high pressure fire system of H. R. Worthington. Under the fountains are casemates whose floors are at a level of 7 feet below the surface of the water in the lagoon. The illumination is accomplished by 38 projector lamps of 90 amperes each, carrying burnished silver parabolic reflectors. The service is on the Edison three-wire system, the lamps being placed across the mains in parallel. The fountains will be controled simultaneously from the northeast tower of Machinery Hall. The same generators used for charging the accumulators for the electric launches will supply current to the fountains by night.

The General Electric system of ship lighting is shown on board the battle ship, "Illinois." Between decks are situated two standard direct-coupled naval iron-clad generating sets, while the variously shaped globes covering the lights in cabins, in bunkers at the mast heads and elsewhere are fitted with absolutely steam tight, and therefore watertight, joints. A 150 centimetre projector with a 200 ampere lamps, the largest search light projector ever made in this country, as well as several smaller ones, will also be shown on board in actual operation.

The Intramural Railway is just beginning to get into condition and will form the subject of a separate article later on, when it is ready for proper description.

All that has thus far been touched upon is really outside of the company's exhibit proper, forming the practical or working part of the show. The other part, that in the Electricity Building, embraces everything within the province of applied electricity. In a conspicuous position near the great tower stands the first direct-coupled generator and engine ever made. "Jumbo" looks primitive when compared with the new and beautiful pieces of mechanism on every side, but after all, the old generator did good service for 11 years in the Pearl street station of the Edison Electric Illuminating Company, of New York, by whom it was loaned to the General Electric Company, and it is held in such veneration that when a part of the insulation was injured by fire some years ago it was never repaired because, as was very truly said, it would not be the same machine if any new material were added to it. In this space also are various types of incandescent lamps of every voltage, and also what is claimed to be the only comprehensive feeder-and-main system of distribution.

The alternating system is shown in the last centre space, while across the aisle the multiphase system is exhibited. Here one may also see the application of electricity to marine service; small compact dynamos of high efficiency directly driven by high speed engines. Here are also search lights, signaling devices, hoists adapted to marine use, ship pumping plants, etc. Long distance transmission of power for mining and kindred uses is illustrated, and motors are exhibited applied to locomotives, elevators and hoists. The display of railway generators, motors and apparatus is large and comprehensive, and will be described in a special article.

At one side of the main aisle in an enclosure by itself is the model arc light plant, at once an exhibit and an operating electric light station. This supplies current to a large number of lamps in actual use for the lighting of the building, and at the same time shows how a central station might look under the most favorable conditions.

This is necessarily but a brief and cursory outline of the work done, or rather being done, by this great company, for in many instances in the description, the future tense might be substituted for the present, and the difficulties in the way of one who would accurately describe what yet remains to be accomplished are both many and varied. What is finished, though, is well done, and the rest is being pushed as rapidly as the horrible weather we are now having, and the other unavoidable hindrances, will permit, and is a credit even now to the splendid engineer corps and executive talent of the General Electric Company.

THE WORLD'S FAIR ELECTRICAL EXHIBITORS.

THE Department has not received the names of the individual foreign exhibitors, so they are not on this list. The spaces occupied by the governments are so marked on maps and are, therefore, not referred to by letter and figure as are the others. In this list "city," stands for Chicago. The map diagrams have been given already in THE ELECTRICAL ENGINEER.

Z	1	Ansonia Elec. Co., Chicago, Ill.
G	1	American Bell Telephone Co., Boston, Mass.
M	1-2	Anthony Elec. Inst. Co., The, Chicago, Ill. (F. A. Baux, Agent).
E	4	Arnold Mfg. Co., Chester. Penn.
S	14	American Graphophone Co., Washington, D. C.
T	9a	American Battery Co., Chicago, Ill.
H	2	American Engine Co., Bound Brook, N. J.
A	7	Acme Filter Co., St. Louis, Mo.
Z	1	American Elec. Heating Co., Boston, Mass.
Z	1	Ansonia Elec. Co., Chicago, Ill.

L	6-7	Brush Elec. Co., The, Cleveland, Ohio.
Y	24	Billings & Spencer Co., The, Hartford, Conn.
H	2	Bemis Car Box Co., Springfield, Mass
A	4-5	Briggs Orlando, 227 S. Clinton St., Chicago, Ill.
A	7	Burton Elec. Co., Richmond, Va.
E	2	Belknap Motor Co., Portland, Me.
U	13a	Bottome, Turner D., Indianapolis, Ind.
T	2	Brixey, W. R., 203 Broadway, New York., Kerite.
S	16	Benham, A. D., Chicago, Ill.
Y	43	Bates Mfg. Co., Chicago, Ill.
		Baxter Elec. Motor Co., Baltimore, Md.

A	2	"C. & C." Elec. Motor Co., The, New York.
T	3	Cutter, Geo., Chicago, Ill.
R	2	Consolidated Elec. Storage Co., The, Philadelphia, Pa.
L	1	Crocker-Wheeler Elec. Co., New York.
Y	2	Commercial Cable Co., The, New York City.
T	15	Chicago Elec. Wire Co., of Wilmington, Wilmington, Del.
F	4	Commercial Elec. Co., Indianapolis, Ind.
U	8	Central Elec. Co., Chicago, Ill.
Y	14	Copenhagen Aut. Fire Alarm Co., The, Chicago, Ill.
T	7	Cooper Elec. Heater Co., The, 301-303 Rookery, City.
F	5	Chicago Belting Co.. 30 W. Randolph St., Chicago, Ill.
H	2	Case Engine Co , J. T. The, New Britain, Conn.
A	7	Campbell Elec. Supply Co., The, Boston, Mass.
U	13a	Crowell Gilmer, Brooklyn, N. Y.
		Crane Elevator Co., Chicago, Ill.
F	7	Curtis Elec. Mfg. Co., Jersey City, N. J.
E	6	Carpenter Enamel Rheostat Co., Bridgeport, Conn.
A	6a	Cleveland Elec. Mfg. Co., Cleveland, Ohio.
L	4	Colburn Elec. Mfg. Co., Pittsburgh, Penn.

S	6	Devey, Matthew H., 353 Parker St., Chester, Pa.
R	5	DuLaney Clock Co., The, Chicago. Ill.
A	7	Diamond Elec. Mfg. Co., Peoria, Ill.
L	5	Degenhardt, F., Chicago, Ill.
T	10	De La Frere, Minneapolis, Minn.
L	4	Diamond Mills Emery Co., Philadelphia, Pa.

Y	31	ELECTRICAL ENGINEER, THE, New York City.
Y	21	Elgin Acoustic Telephone Co., Elgin, Ill.
U	14	Eureka Tempered Copper Co., North East, Erie Co., Pa.
Y	27	Electrical Industries Pub. Co., City.
D	2	Electrical Forging Co., Boston, Mass.
Y	30	*Electrical Review*, New York City.
Y	33	Electricity Newspaper Co., New York City.
U	19	Electric Selector & Signal Co., New York City

Y 15 Electric Heat Alarm Co., Boston, Mass.
B 8 Eddy Elec. Mfg. Co., The, Windsor, Conn.
W 1 Elec. Adver. & Display Mfg. Co., Philadelphia, Pa.
Y 36 Electrical Machine Co., City.
U 16 Electrical Appliance Co., City.
B 5 Excelsior Elec. Co., New York.
Egan Chas. E., Englewood, Chicago, Ill.
S 14 Empire China Works, Brooklyn, N. Y.
Y 18a Electric Med. Battery Co., The, Kalamazoo, Mich.
J 1 Edison, Thomas A., Orange, N. J.
Y 18b Edgerton E. M., City.
E 3 Elwell-Parker Elec. Construction Co., of America, Chicago, Ill.
Y 28 *Electrical World*, New York.
P 1 Electrical Conduit Co., New York City.
P 4 Elektron Mfg. Co., The, Springfield, Mass.
U 13b Elec. Gas Ltg. Co., Boston, Mass.
P 9 Elliott Elec. Co., Cleveland, Ohio.
S 21b Electrical Specialty Co., The, Denver, Colo.
D 2 Eco Magnetic Clock Co., Boston, Mass.
U 16 Emerson Elec. Mfg. Co., St. Louis, Mo.
S 2 Edison Mfg. Co , New York.
Z 1 Edwards & Co., New York.
Z 1 Elec. Mfg. Co., Dayton, Ohio.
Elec. Launch & Nav. Co., New York.
Z 1 Elec. Thermostat Co., Minneapolis, Minn.
O 2 Elec. Pipe Bending Co., Harrison, N. J.

M 3 Ft. Wayne Elec. Co., Ft. Wayne, Ind., City.
U 15 Ford-Washburn Storelectro Co. Cleveland, O.
S 7 Franklin Elec. Appliance Co., Boston, Mass.
M 3 Falls Rivet & Machine Co., New York.
E 7 Fein, C. & E. Stuttgart, Germany.
Frisbie & Co., New Haven, Conn.

T 4 Guillaume, Alfred, City.
W 5 Gray, Elisha, Highland Park, Ill.
F 8 Greeley, E. S. & Co., New York.
B 4 General Elec Co., Jackson Park.
C 1 do
H 2 do
J 1 do
M 4 do
N 1 do
O 8 do
V 1 Gamewell Fire Alarm Tel. Co., City.
C 1 General Fixture Co., New York.
A 4-5 Granton & Knight Mfg. Co., Worcester, Mass.
Y 46 Gault & Co., N. C., Winona, Minn.
V 1 Gamewell Fire Alarm Tel. Co., City.
H 2 Griffin Wheel & Fdy. Co., City.
N 11 Goulds Mfg. Co., Seneca Falls, N. Y.
S 17 Goldkiss, O. F. Co., City.
E 6 General Incandescent Arc Lt. Co., New York.

O 4 Heisler Elec. Co., Philadelphia, Pa.
V 1 Holmes, N. L., Ann Arbor, Mich.
A 4 Healy & Millets, City.
Y 11 Hope Elec. Appliance Co., Providence, R. I.
S 3 Hirlemen Chas., J. 117 McDougal St., New York.
U 17 Hall, Chas. F., City.
Y 9 Houlehan, Jas., City.
L 4 Hanson & Van Winkle, City.
S 5a Hurd, Jno. F., City.
Z 1 Holtzer-Cabot Elec. Co., Boston, Mass.
Y 21 Hanson Battery Lt. & Power Co., Washington, D. C.

U 16 Indiana Rubber and Ins. Wire Co., Jonesboro, Ind.
S 11 India Rubber Comb Co., New York.
Y 19 Illinois Alloy Co., City.
N 1 Ingersoll-Sargent Drill Co., New York.
U 3 International Aut. Lt. & Power Co., City.
Z 1 India Rubber & Gutta Percha Insl. Co., New York.

L 2 Jenney Elec. Motor Co., Indianapolis, Ind.
U 21 Johns Mfg. Co., New York.
F 6 Jewell Belting Co., Hartford, Conn.
Y 10 Jaeger, Chas. L., Maywood, N. J.
H 2 Jackson & Sharp Co., Wilmington, Del.
B 2 Jewett Supply Co., Boston, Mass.

V 2 K. A. P. Elec. Novelty Co., The, La Crosse, Wis.
S 5b Kosh, G. F., Louisville, Ky.
S 10 Knapp, Geo., City.
T 16b Knight Coin Cont. Aut. Boot Black Co., City.

Lidback, Jno., & Son, Portland, Me.
V 7 Leclanché Battery Co., New York.
Y 34 Lawton, Harry A. & Kennon Mott, Brunswick, Ga.
S 20 Lee, Chas. E., City.
N 1 Lawrence Machine Co., Lawrence, Mass.
H 2 Lake Erie Engineering Works, Buffalo, N. Y.
H 2 Lidgerwood Mfg. Co., New York.

U 12 Munson Lighting Con. Co., Indianapolis, Ind.
Y 12 Marcus, Wm. N., Philadelphia, Pa.
M 1-2 Mather Elec. Co., The (F. A. Baux, Agent), City.
E 5 Mather, A. C. Mather. City.
D 5 Munson Belting Co., The, City.
D 2 Morrill Bros., Brooklyn, N. Y.
W 2 Meyrowitz, E. B., New York.
S 15 Meeker, Dr., Newark, N. J.
R 6 Murphy, T. J., New York.
U 11b McCaskey, Alfred S., & J. A. Ellis, City.
W 3 McIntosh Battery & Opt. Co., City.
U 20a McNeill Tinder Elec. Co., Winchester, Ky.
H 2 McIntosh, Seymour & Co., Auburn, N. Y.

T 11 New York Insulated Wire Co., New York.
Y 20 Nat'l Carbon Co., Cleveland, Ohio.
W 40 Newman Clock Mfg. Co., 279 Dearborn Street, City.
T 16a Norwich Insulated Wire Co., The, 44 Broad Street, New York.
S 12 North American Elec. Co., New York City.
S 23 Non-Magnetic Watch Co., New York City.
S 8 National Engraving Machine Co., City.
H 2 New York Air Brake Co., The, New York.
L 5 National Conduit Mfg. Co., The, New York.
U 16 New York & Ohio Co., Warren, Ohio.
S 2 North American Phon. Co., City.
Y 35 192 New York & London Ass'n. Kansas City, N. Y.
Z 1 333 Nat'l Elec. Mfg. Co., Milford, Conn.
A 3 345 Nat'l Aut. Fire Alarm Co., New York.
L 5 351 Nat'l Conduit Mfg. Co., New York.

Orling, A. J., City.
U 8 277 Okonite Co., The, New York.
T 1 161 Owen, Dr. A., City.
337 Otis Bros. & Co., New York.

U 22 Paiste, H. T., Philadelphia, Pa.
D 5 Page Belting Co., The, City.
T 6 Pumpelly, Jas. K., City.
T 8a Pennock Battery Elec. Lt. & Impl. Co., City.
I 1 Phœnix Glass Co., Pittsburgh, Pa.
U 20b Phelps, A. H., Md., Glens Falls, N. Y.
U 18 Powell Co., The Wm., Cincinnati, O.
V 1 Police Tel. & Signal Co., City.
U 11a Pratt Elec. Med. Supply Co., The, City.
N L Pelton Water Wheel Co., The, San Francisco, Cal.
U 16 Platt, O. S., Bridgeport, Conn.
A 4-5 Pendleton Glass Tube & Pipe Works, Pendleton, Ind.
T 3 Pass & Seymour, Syracuse, N. Y.
Y 45a Pulvermacher Gal. Co., Cincinnati, O.
H 1 Pelton Water Wheel Co., San Francisco, Cal.
Z 1 Pfund, Richard, New York.

E 7 Queen, Jas. W. & Co., Philadelphia, Pa.

R 8 Railway Equipment Co., City.
S 9 Roessler & Hasslacher Chem. Co., New York.
Y 16 Rausher, Jno., St. Paul, Minn.
R 1a Ringler, F. A. & Co., New York.
H 2 Robinson Elec. Truck & Supply Co., Boston, Mass.
A 4-5 Russell & Co., Massillon, O.
Rowell Potter Safety Stop Co., Boston, Mass.
P 2 Rockford Elec. Mfg. Co., Rockford, Ill.
T 5 Reliance Gauge Co., Cleveland, O.
Z 1 Rauda, Otto, New York.

L 5 Standard Underground Cable Co., City. (F. Degenhardt.)
Y 18a Sponholz, Carl L., Lowell, Mass.
T 20 Standard Paint Co., City.
Y 13c Striemer, A., So. Superior, Wis.
T 7 Strowger Aut. Tel. Exchange, City.
Z 1 Stanley Electric Manufacturing Co., Pittsfield, Mass.
D 3 Schieren & Co., Charles A., City.
Y 17 Standard Elec. Signal Co., Rochester, N. Y.
H 2 Stephenson & Co , Jno., New York.
O 1 Standard, Elec. Co., City.
P 2 do
N 1 Steam Stone Cutter Co., Rutland, Vt.
A 4-5 Sosman & Laudiem, City.
T 9b Star Iron Tower Co., Ft. Wayne, Ind.
R 1b Stevens, N. P., Concord, N. H.
L 6-7 Short Elec. Ry. Co., Cleveland, O.
L 6-7 Swan Lamp Manufacturing Co., Cleveland, O.
Smith Pneumatic Trans. and Stor. Co., City.
Self Winding Clock Co., New York.
A 6b Sloss Elec. Gaslight and Specialty Co., City.
Z 1 Star Elec. Pump Co., City.

S 4 Todd, John T., City.
O 2 Thomson Elec. Welding Co., Boston, Mass.
C 1 Thomson Houston Elec. Co., Lynn, Mass.
Y 45b Thermo Elec. Heat Regulating Co., Easton, Pa.
H 2 Taylor Elec. Truck Co., Troy, N. Y.
A 7 Taylor, Goodhue & Ames, City.
Y 37 Tate, D. D., 269 W. Van Buren street, City.

F 3 Union Elec. Co., New York.
F 8 Union Elec. Co., New York.
R 4 Utica Elec. Mfg. and Supply Co., Utica, N. Y.
T 23 Union Elec. Works, City.

W 2 Vetter, J. C., & Co., New York.
U 16 Vail, W. A., New York.
R 6 Van Nuis, C. S., New York City.

A 4-5 Western Elec. Co., City.
V 3 Washburn & Moen Mfg. Co., Worcester, Mass.
Y 32 *Western Electrician*, City.
R 6 Weston Elec. Inst. Co., Newark, N. J.
B 1-2 Westinghouse Elec. and Mfg. Co., Pittsburgh, Pa.
H 1 do
F 1 do
V 8 Western Union Tel. Co., City.
P 10 Wing, L. J., & Co., New York.
T 17 Waddell-Entz Co., The, Bridgeport, Conn.
Y 44 Webb, C. F., Dr., Cleveland, O.
Y 13b Wullweber & Co., O. L., City.
U 26 Waite & Bartlett Mfg. Co., New York City.
S 18 Willoughby, Chas., San Francisco, Cal.
U 27 White Dental Mfg Co., E. S., The, Philadelphia, Pa.
E 7 White, Jas., Glasgow, Scotland.
N 1 Webster Mfg. Co., City.
H 2 Wharton, Wm., Jr. & Co., Philadelphia, Pa.
U 16 Whitney Elec. Inst. Co., Boston, Mass.
A 7 Wagner Elec. Mfg. Co., St. Louis, Mo.
H 2 Walworth Mfg. Co., Boston, Mass.
A 6a Wilder Duplex Elec. Burglar and Alarm and Mess. Co., City.

F 2 Zucker & Levett Chem. Co., 14 Grand street, New York.

ARC LIGHTING IN THE WORLD'S FAIR GROUNDS.

CONSIDERABLE use is to be made of arc lights or ornamental posts, all over the World's Fair Grounds. Provision is made for 1,550 lamps for ordinary lighting and 250 patrol lights placed at irregular intervals around the grounds, at the angles of buildings, etc. About 250 miles of No. 6 wire will be used for the circuits. The conduits for carrying the mains have already been described in THE ELECTRICAL ENGINEER.

THE EXHIBIT OF THE H. W. JOHNS MANUFACTURING CO.

A very tasteful and attractive display is being made by the H. W. Johns Manufacturing Co., of New York City, who have in all six separate exhibits scattered over the grounds. That in which electricians will be most directly interested is in the southwest gallery of the Electricity Building in section U. Here are shown the materials made famous by the company wherever electricity plays a part; vulcabeston, moulded mica, monarch asbestos, and other insulating compounds in a great variety of forms, as well as all manner of line materials.

The space occupied by the H. W. Johns Manufacturing Co. is marked at the four corners by large white globes supported upon ornamental columns, and from these extend brass railings enclosing the entire area. One end of the space is occupied by a Grecian temple of graceful design which serves as an office, furnished handsomely with desk, chairs, telephone stand, Turkish rugs and all the luxurious accessories appertaining to well-appointed private sanctums, while the rest of the inclosure is devoted to handsome French plate show cases and stands containing the apparatus exhibited. Near the centre is a large urn-shaped stand of solid antique oak on which are festooned strings of globe strains. In one corner is a counter from which samples of asbestos, etc., will be distributed to souvenir hunters, and in the cases are shown material exhibiting the several steps in the manufacture of moulded mica, vulcabeston, and other compounds. In one case are asbestos materials for all sorts of electrical purposes; several others are devoted to moulded mica and monarch samples, while still others contain an enormous variety of vulcabeston pieces used in the insulation of dynamos, motors, etc.

There is also shown a large number of magnet spools for street car motors and the like, and special pieces for the street car controlers of the Westinghouse and General Electric Companies, while distributed about the space are pieces of insulated electric apparatus in great variety; arc lamps, tools, controlers, etc., of different makes, showing the application of insulating materials, while a large sample-board is filled with specimens of moulded mica line materials.

Probably the most striking feature, however, of the entire display is the large illuminated sign. This is a black board, 28 feet long by 4½ feet wide, bearing the name of the company, and, superposed upon this, the word "Insulation." The former is picked out in small white lamps and the latter in red, and each is on a separate circuit controlled by an automatic commutator-switch operated by a small motor. The two legends thus appear one at a time in different colors and cannot fail to attract the eye. Moreover the board is so placed as to be visible from almost any part of the building.

The H. W. Johns Mfg. Co. have no intention of hiding their light under a bushel and indeed it would take a bushel measure of Chicagoan dimensions to accomplish such a result. All of the material used in the display, wood-work, brass, or what not, is the best and most solid obtainable and the exhibit will attract a great deal of well-deserved attention. Mr. W. F. D. Crane, who is in charge of the work, has devoted to it much labor and time, and to him is due in a great degree the creditable result.

"FERRACUTE" AT THE FAIR.

The Ferracute Machine Company, of Bridgeton, N. J., have recently shipped two full carloads of machinery for their exhibit at the Columbian Exposition. This machinery consists of 12 power presses, the largest weighing 12,000 lbs., four foot presses, three spinning lathes, polishing machinery, several smaller machines for beading, trimming, threading, etc., and about 40 pairs of dies. They have secured an excellent space 30 by 25 feet on the corner of two principal aisles and under one of the electric cranes, in section 13, columns IJ, 42 and 43, in the centre of Machinery Hall Annex, near the large engines. This will be handsomely fitted up with a line of shafting, an engine of their own, counter, benches, an office, and with a large line of samples showing every kind of sheet-metal work.

All of this machinery will be kept running with a number of operators, and several different articles will be manufactured in tin, brass, aluminum, etc., in order to show the practical working of their presses, dies, etc. They have made a contract with the Pittsburgh Reduction Company, to manufacture all the articles from the thin metal which is made in aluminum in the exposition grounds, and this in itself will be an interesting object to visitors, as aluminum is now being used for so many household articles in addition to fancy goods, etc. Among other articles manufactured by the Ferracute Company will be pie-plates, pans, skillets, drinking cups, fancy plaques, jewel boxes, napkin rings, puzzles, etc., etc., and their exhibit will illustrate a complete metal-working establishment.

Mr. Fred F. Smith, secretary of the company, will be in charge of the exhibit, assisted by the foreman of their press shops, Mr. Edmund Hoffman, with one or two assistants from the factory, and others whom they will secure in Chicago.

Nearly all of the machinery exhibited will be from new designs recently brought out and will show all the latest developments in sheet-metal presses and dies. They will be glad to see all of their friends at the location above mentioned, and will shortly have a handsome catalogue to present to them representing their new lines of machinery.

MISCELLANEOUS.

IMPEDANCE.[1]

BY A. E. KENNELLY.

The impedance of a conductor is stated as its apparent resistance expressible in ohms, with the addition of the definition adopted at the Paris Congress of 1889, as the ratio of the E. M. F. to the current. Under this condition if I denotes the impedance of a circuit, Ohm's law generalized becomes $C = \frac{E}{I}$, and then applies to both alternating and continuous currents.

The rules are then given for the geometrical and arithmetical combination of impedances. The formulas for arriving at these results have been obtained by Rayleigh, Fleming, Bedell, Crehore, and others, but they are here for the first time shown to be subject to all the usual rules of continuous current circuits. Examples of such cases are examined in detail.

The application of impedance principles to measuring instruments for alternating currents is next examined and two actual examples selected. Thus a particular Thomson wattmeter is quoted as having an armature circuit resistance of 455.5 ohms and an impedance of 456.0 ohms, so that this instrument indicates, owing to impedance, less on alternating than on continuous currents, by one-ninth of one per cent.

The impedance of copper wires suspended on poles in pairs is next considered, with its application to alternating-current distribution of light and power. Tables have been computed whose results are shown in curve diagrams for direct inspection, and for the frequencies of 40, 60, 80, 100, 120 and 140 periods per accord. In these curves, the impedance factors are found from the size of wires and their distance apart. Thus for a pair of No. 000 B & S wires employed as conductors for alternating current supply at 140 periods and suspended 100 inches apart, the drop is shown to be nearly six times as great (5.8) as with the same strengths of continuous current. Such a size of wire and distance of separation would certainly be exceptional, but with common sizes and distances the impedance factors are often 1.5, representing drops of 50 per cent. in excess of what would be found with equal strengths of continuous current. The tables and curves are shown to apply to interior and secondary wiring, as well as primary circuits, and to triphase conductors when all three wires are equidistant. In order to determine the drop on such alternating current supply mains, it is only necessary to ascertain the continuous current drop by the usual tables or by computation of resistance, and to then multiply this drop by the impedance factor taken from the curves for the frequency, size of wire, and distance employed.

The influence of current wave character is then taken into account. It is pointed out that the tables and curves only apply to pure sine waves, for which the impedance factors are always minima. All departures of the current waves from the simple harmonic type give rise to increase in the drop, and augment the impedance factors. The augmentation can be computed when the shape of the current waves is known. A simple way to ascertain therefore whether current waves in a circuit are sinusoidal or not, is to pass the current through such a pair of overhead wires, or through any choking coil of copper wire without iron core, having known resistance and inductance,—consequently known (small) impedance for the frequency employed,—and to compare the observed voltage across the terminals of the coils with the product of the impedance and current strength. If the current waves are approximately sinusoidal, the observed and computed drops will approximate, but the greater their divergence, the more marked the departure from the sinusoidal form.

The impedance of iron wires is finally examined from an experimental point of view, and it is shown that the impedance or apparent resistance to alternating currents of a loop of iron wire is not constant but depends upon the strength of the current it conveys. As the current strength increases, the impedance rises, attains a maximum, and then decreases again.

The mean inductance of small wires of iron suspended on poles as in telephonic conductors, is shown to be experimentally about 12 millihenrys per mile more than if the wires were of copper.

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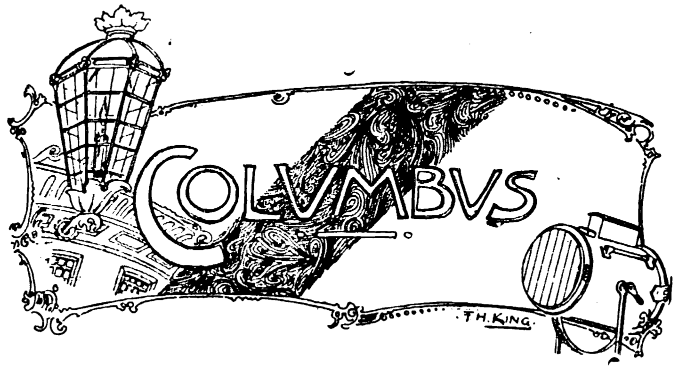
[1] Abstract of a Paper read before the American Institute of Electrical Engineers, April 18, 1893.



COLUMBUS CELEBRATIONS IN NEW YORK.

The past week in New York City was largely devoted to Columbus celebrations, preliminary to the opening of the World's Fair in Chicago. The three ships modeled strictly after the caravels of Columbus,—the "Santa Maria," "Pinta," and "Nina,"—were escorted to the North River early in the week by Spanish men-of-war, and then a fleet of nearly 40 men-of-war, representing 10 different nations, formed line below them, on either side the river, stretching from Ninety-fourth street to Thirty-fourth, the American cruiser "Philadelphia" and the British cruiser "Blake" heading the respective columns. On Thursday, this grand fleet was reviewed by President Cleveland, from the dispatch boat "Dolphin," amid surroundings of great grandeur and in sight of two or three million people, of whom a very large number were afloat in every craft that could brave the chill April breezes.

At night, the fleet paralleling each shore for two or three miles, set itself to work and gave New Yorkers a vivid idea of what can be done with electricity. The four British men-of-war were magnificently outlined from stern to stern and from water line to truck with incandescent lights, while the displays of like nature on the German, French and other men-of-war were almost as fine. Then came the search light display, and as many as a full score of "searches" flung their beams at once athwart the foggy sky, making a wonderful tartan of light and dark. To this succeeded night signaling on all the ships, and then a brilliant exhibition of fireworks by the enthusiastic Britishers, who, on board the "Blake," lit up a fiery portrait of Washington, amid cheers that rolled from the shores and the deep like distant thunder. It was a great night.

After this spectacular performance came a grand ball at Madison Square Garden, given by the city, and attended by thousands of citizens and guests. Here again a most brilliant use was made of electricity. The main entrance of the Garden was decorated with cut flowers and electric bulbs. At each side were silver dragons with incandescent eyes. In the centre of the floor was erected an arch, on top of which sat a cupid made of small electric lights. At the base of the arch were six electric wheels, each carrying a design in miniature lamps which changed color as the wheels revolved. Surrounding this were groves of palms, roses, lilies, and tropical plants.

At the Fourth avenue end of the Garden was an immense Japanese fan, 20 feet long and eight feet high, outlined in miniature lamps. The current was turned off and on at intervals, producing the illusion of the fan's opening and shutting. Just under the fan was placed the reception platform, on each corner of which were two silver dragons similar to those at the front entrance.

All the posts around the great floor were festooned with smilax and palms, thickly studded with miniature lamps.

On the stage of the assembly room was a model of the United States Capitol at Washington, the interior illuminated with electric lights, and the grounds laid out with natural plants in imitation of the original. The balcony was garlanded with greens and delicate blossoms, harmonizing with the general scheme of the decoration of the room. In the centre of the balcony front was placed a large silver spray of laurel leaves, the berries being represented by incandescent lamps. The front of the balcony was hung with large plaques of roses, each containing a bouquet of electric light. The effect of all this lighting was indescribably beautiful. The electrical decorations were left in the Garden until Saturday, so that they might be seen by persons attending the concerts given by the two fine German military bands en route for Chicago.

OPENING THE WORLD'S FAIR.

The Columbian World's Fair at Chicago, was duly opened by President Cleveland on Monday morning, surrounded by members of his cabinet, Vice-President Stevenson, the Duke of Veragua and other descendants of Columbus; the World's Fair authorities and a host of other people of higher and lesser degree. The march to the grounds was joined in by large bodies of regular soldiers and militia and a great many civic societies. The ceremonies connected with the opening took place in front of the Administration Building, and then President Cleveland started the machinery. The button which President Cleveland touched on Monday to start the machinery of the exposition is in the shape of a "Victor" telegraph key and is of solid gold, with an ivory button on the handle. It sits on a pyramid of blue, gold and plush 12 inches high. The colors represent those of the American and Spanish nations. On the base of the pyramid are the figures 1492–1893 in silver. The current for the circuit to Machinery Hall was furnished by a single cell of "Ajax" dry battery. This battery is 30 inches high by 12 inches in diameter and was furnished by The Ansonia Electric Company of Chicago. It was used on a temporary circuit connected with the President's stand and the valve of the big Allis-Corliss engine, which is one of the principal sources of power on the Exposition Grounds. President Cleveland "pushed the button and Ajax did the rest," all the other engines taking their cue from the one started. This battery is on exhibition in the pavilion of The Ansonia Electric Company, north end of gallery, Electricity Building.

LEGAL NOTES.

RUTLAND ELECTRIC LIGHT COMPANY vs. MARBLE CITY ELECTRIC LIGHT COMPANY.

The Rutland Electric Light Company, after long continued litigation with the Marble City Company have secured a perpetual injunction restraining the Marble City Company from so erecting its poles or stringing wires as to interfere in any manner with their poles or wires. The decree of the court provides also that a master be appointed to determine the amount of damage sustained by the Rutland Electric Light Company by the Marble City Company's infringements on their rights and property.

The decree has been confirmed, with an order for the removal of all conflicting wires and poles of the Marble City Electric Light Company, by the Supreme Court of the State of Vermont. Chief Justice James M. Tyler presiding.

THE GENERAL ELECTRIC CO. SUED FOR INFRINGEMENT OF A CONVERTER PATENT.

On April 29, the Westinghouse Electric and Manufacturing Co. brought suit in the United States Circuit Court, against the General Electric Co. for infringement of patent No. 373,029, issued Nov. 8, 1887, and for which application was filed April 14, 1887. The patent was granted to and assigned by Mr. O. B. Shallenberger, and covers the primary and secondary coils of a converter, separately insulated.

LETTERS TO THE EDITOR.

THE INFLUENCE OF FIELD STRENGTH ON MOTOR SPEED.

Will you kindly answer the following questions for me in your paper: 1. What are the circuits of the Thomson wattmeter, as manufactured by the General Electric Company, as regards the armature and field? 2. In a motor with a high resistance armature and separately excited fields, will the motor upon increasing the field beyond a certain degree slow down?

Albany, N. Y. J. L. Work.

Answer:—1. In the Thomson wattmeter the fields are in shunt to the armature.

2. The motor will certainly slow down in proportion to the increase in the number of lines of magnetic force produced in the field by the increase of current in the field circuit. It really does not matter whether the field ampere-turns are obtained from a series, or shunt, compound or separately excited coil,—the effect is always the same on the armature.

The E. M. F. of a motor, E, depends on three factors, viz., length of wire on armature L, speed of armature V, and strength of field, H. So we can say $E = H L V$.

Now since L is constant, and $\frac{E}{H}$ is also, it follows that when we vary one of the two variable factors (H, V), the *increase* of one (H) must determine a corresponding *decrease* in the other (V). In other words, if the field is increased the armature slows up (for a given torque); if *decreased*, the armature increases in speed. There are a number of systems of regulation based on this fact.

Eds. E. E.

CREDIT TO MESSRS. STANLEY AND KELLY'S ASSOCIATES.

In connection with the article in your issue of the 26th inst., allow us to say that throughout the development of our system we have received great aid from all our associates, and that we are indebted to them for valuable suggestions, especially so to Messrs. C. C. Chesney and W. B. Tobey.

William Stanley, Jr.,
John F. Kelly.

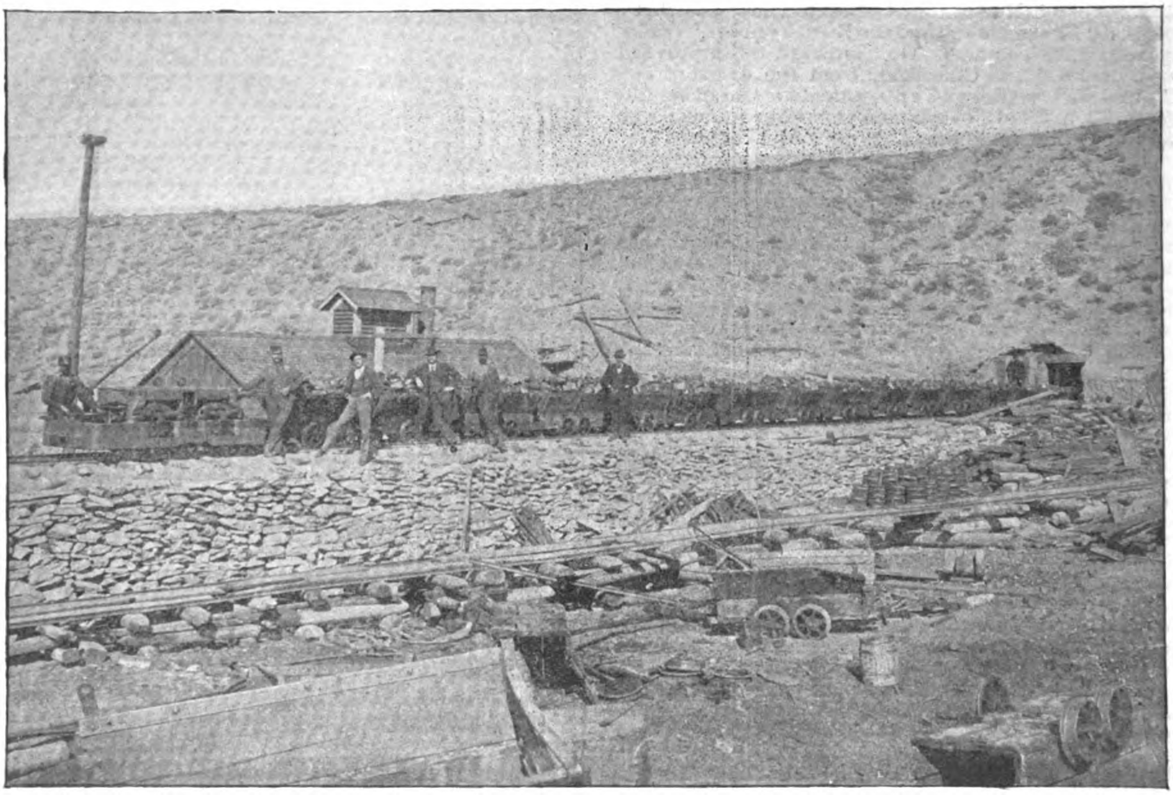
Pittsfield, Mass, April 28, 1893.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC HAULAGE IN THE ROCK SPRINGS COAL MINES, WYOMING.

THE problem of economic haulage in mines has lately received considerable attention from mine owners, who have found the expense involved in haulage alone much greater than in their opinion it should be. The mule has had his day as the principal factor in the haulage question, and the cable is under test, with results more or less satisfactory. The electric locomotive for mine work is comparatively a new comer in the haulage field, but it has already acquired considerable prestige and bids fair to supersede both the mule and rope haulage.

An excellent example of the work done by the electric locomotive in coal mining is shown at the Rock Springs Coal Mine, at Rock Springs, Wyo. This plant was installed by the Mining Department of the Northwest General Electric Company. About a mile from the mouth of the mine, the power station, containing a dynamo of 80 h. p. driven by a steam engine, is located. Current from this is delivered at a pressure of 550 volts, which allows of a drop of about 10 per cent. between the power house and the mine.



GENERAL ELECTRIC MINING ROAD, ROCK SPRINGS COAL MINES, WYO.

The feed or supply wire is No. 000 hard drawn bare copper, making a complete metallic circuit. The trolley line is furnished with a circuit breaker about 30 feet from the mine mouth, so that the current may be cut off from the mine when the locomotive is employed for switching purposes outside.

The locomotive used is of the G. L. M. General Electric Company type, of 30-inch gauge, 60 h. p., recently described in our columns. Its usual speed in this instance is about eight miles an hour. The cars used are of the ordinary coal mine type, weighing each, when filled, about 3,000 lbs., and when empty, about 1,000 lbs.

The economy attained is strikingly illustrated by the fact that 30 cars were run from the loading point to the end of the track, a distance of about 6,000 feet, there dumped and returned to the mine in 20 minutes. On another occasion the locomotive drew after it 30 loaded cars, and pushed ahead 16 others from end to end of the road without difficulty. The track is built of 35 lb. T-rail and has several switches and spurs necessary to the rapid handling of the cars.

It is not inapropos here to quote from a letter from the expert giving an account of contact with the bare wire and the results thereof:

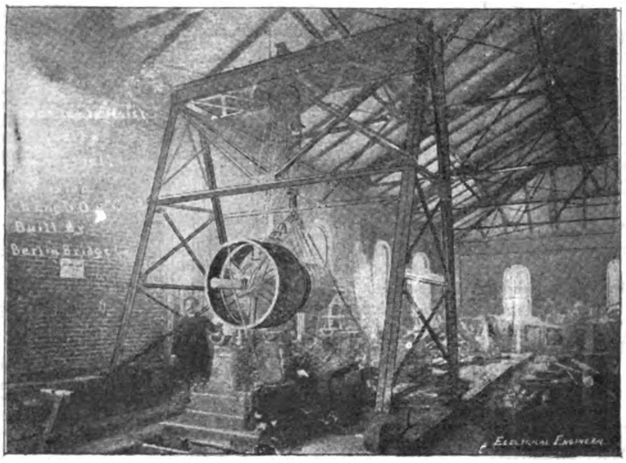
"Several men have been shocked since our plant began operating, but the effect is only momentary and they only laugh at it. The result has simply been to remove all fear they had of it. As I stated in my letter, this is a very dry mine and so the only way one can get shocked is to stand on a rail and touch the wire. I have been shocked several times myself while handling the locomotive, through thoughtlessness. The other day a balky mule ran right into the wire with his head. He was knocked down. He got up and ran into it again three times and was dropped in every instance. After that he simply turned around and walked off to his work. I ought to remark that the shock does not knock a man down or burn him. The only description I can give of its effect from personal experience is a tingling sensation, lasting, in the heaviest shock I received, not more than one or two minutes afterwards in the hand that made contact."

This last is a fact which should reassure mine owners who have any fears of danger from contact with the trolley wire. The element of danger once recognized as entirely absent, the electric locomotive can compete on equal grounds with any other system of haulage, with many points in its favor which cannot be urged for its competitors. We expect to see its adoption become general, both on account of the economy of its operation and of its convenience of manipulation.

THE JOHNSTON PORTABLE IRON HOIST.

IN the equipment of electric railway and light stations, provision must be made for the handling of heavy dynamo and engine parts, not only during erection, but also for making the necessary repairs and easy inspection. For this purpose traveling cranes are usually employed. These handy tools while fulfilling their object in an admirable way are usually very expensive affairs in themselves; but in addition to this their great weight requires that the walls by which they are supported and along which they travel be built heavier than would otherwise be the case, hence involving additional expense in building.

Having both these drawbacks in view, **Mr. A. Langstaff Johnston**, consulting engineer of Richmond, Va., in designing the power house of the New Orleans and Carrollton Railway Company, at New Orleans,[1] decided to adopt an arrangement which, while obviating the use of a traveling crane should nevertheless be capable of exercising all its functions. To carry out his plans he designed the portable iron hoist, shown in the accompanying engraving, which was built by the Berlin Iron Bridge Company, of East Berlin, Conn.



JOHNSTON PORTABLE HOIST, NEW ORLEANS AND CARROLLTON POWER HOUSE.

As will be seen, the hoist consists of a wrought iron A-frame mounted on wheels. These wheels are provided with holes and by applying crow bars as levers, two men are able to shift the crane with its maximum load of four tons. The hoist travels on planks laid on the floor.

In the erection of the machinery on the railway power station at New Orleans this hoist was used exclusively and showed itself to be an eminently handy and economical tool.

SOCIETY AND CLUB NOTES.

CHICAGO ELECTRIC CLUB.—ELECTION OF OFFICERS.

THE annual election of officers of the club took place on April 20, and resulted in the selection of the following gentlemen:

President, J. P. Barrett; first vice-president, F. W. Parker; second vice-president, E. Baggot; third vice-president, F. W. Cushing; fourth vice-president, George Cutter; secretary, F. L. Perry; treasurer, J. W. Johnson; managers, F. W. Horne, chairman; L. A. Ferguson, S. A. Douglas, M. A. Knapp, J. W. Buckley, E. C. Ferguson, C. T. Page, A. S. Terry, Ben. Williams, L. S. Hills; membership committee, C. C. Haskins, Thomas G. Grier, D. G. McDougall.

After the announcement of the result, Prof. Barrett thanked the club for the honor conferred upon him, and expressed his conviction in the continued prosperity and growing influence of the club.

CALIFORNIA ELECTRICAL SOCIETY.

THE officers of the California Electrical Society for the ensuing year are: Geo. P. Low, president; C. O. Poole, vice-president; Max Caspari, secretary, and H. T. Bestor, treasurer. On April 17, President Low read a paper entitled: "What the Electrician Finds of Interest in Southern California."

AMERICAN STREET RAILWAY ASSOCIATION.

THE twelfth annual meeting of the above Association is to be held at Milwaukee on Wednesday, October 10 and two following days. The exhibit will be made in the Milwaukee Industrial Exposition Building, which has been engaged for two entire weeks, beginning October 9.

PATENT NOTES.

THE VAN DEPOELE TROLLEY PATENTS.

WE have received the following item from the General Electric Company relative to two patents recently noted in our columns:

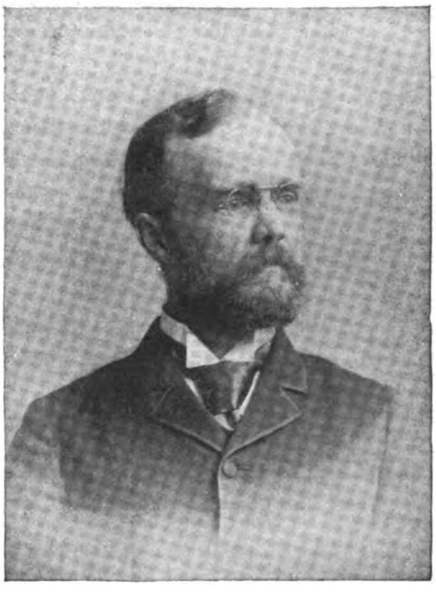
"After several years of contention and interference before the Patent Office, two broad fundamental patents have been granted to Chas. J. Van Depoele, covering all the essential features of the trolley. The patent is assigned to the Thomson-Houston Electric Company.

"In detail, the claims allowed cover first, the underneath contact made either by a rolling wheel or a sliding-spoon contact piece, secondly the converse of these two cases, and thirdly, the reversibility of the trolley pole on top of the car, enabling the contact to be made on either side of the trolley, as the case may be.

"The possession of this patent practically means, the entire control of the overhead system throughout the United States. This so far is the only system which has proved successful, no serious rivalry having yet been shown by either the storage battery or the underground conduit. The patent has been and continues to be infringed by several companies. The acknowledgement of the claims under this patent granted to the dead inventor, made by the Patent Office, is an important victory for the General Electric Company, which will most likely be followed by very important results to the entire street railway fraternity."

PERSONAL.

HENRY CLARK TOWNSEND.[1]



Henry Clark Townsend.

HENRY CLARK TOWNSEND is well-known in the professional world, and among electricians and scientists. Born in Cambridge, in 1850, he went to Washington in 1862, where his father was ordered on public business. His classical education began at the Rittenhouse Academy, and was completed at Harvard College, where he was graduated in 1871, in the class with the Hon. Henry Cabot Lodge, H. McK. Twombly, Edward Burgess, and others well-known.

In college he was a member of the $\Phi B K$ honorary society, and of other well-known organizations. Having pursued and finished his law course at the Columbian Univ. Law School in Washington, he was admitted to the bar.

At this period he devoted his study to matters electrical, being confident of the great field then opening before the world.

His ambition and perseverance in this direction procured for him the position of Principal Examiner in the United States Patent Office in the Class of Electricity, which position he held for four years, when he resigned to accept a lucrative practice in New York. While in control of the division of electricity, many of the great inventions which marked the beginning of the present era of inventive and industrial activity in matters electrical, passed his approval. After this period began his connection with the American Union Telegraph Company, the Baltimore and Ohio Telegraph Company, and numerous prominent electric light and electric manufacturing corporations, including the American Electric Company of New Britain, succeeded by the Thomson-Houston Electric Company, now so famous, and with which he has been connected up to the present time in numerous and important contests.

Mr. Townsend is a direct descendant, on his mother's side, of the Bacon family of Bedford, Mass., his ancestors settling there in 1640. The Bacon homestead was built in the 17th-century, and is still standing. Six generations of them were born or lived in this famous house. Some of his ancestors were heroes in King Philip's war, and all were noted for their courage and integrity. The great-great-grandfather of Mr. Townsend, Jonathan Bacon, was the "principal inhabitant" and "Selectman" appointed to assemble the people in the first town meeting of Bedford. Jonathan's brother and sons were in the Concord fight, and it is a matter of history, that of the 26 "minute men" from Concord, six were Bacons.

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[1] For a full description of this plant see THE ELECTRICAL ENGINEER, April 19 and 26.

[1] *University Magazine*, April, 1893.

Upon his father's side he is descended from Thomas Wilder or (Wyellder) and Robert Townsend, of Lancaster, Mass. The Wilders settled there in 1639, coming from Lancaster, England. They were called the blue-blood of that part of the country, and were noted for their great learning. They and the Townsends intermarried, the Wilder homestead coming at last into possession of the Townsend family.

Mr. Townsend is a club man, courteous and affable in manner, and amiable in disposition, well-known by his energy, ability and integrity. There is perhaps no better representative of the New York College man in the peculiarly difficult profession in which he has made his mark.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED APRIL 25, 1893.

Accumulators :—

Storage Battery, F. A. La Roche, Philadelphia, Pa., 496,126. Filed March, 25, 1892.

Designed to retain, in part, the gases evolved in charging the battery. Claim 1 follows:

In a storage battery, a cell, electrodes and battery liquid in combination with a receptacle, inclosing one of the electrodes above the battery liquid and having the portions below the liquid level porous and the portions above the level of the battery liquid impervious to the gases generated in the battery.

Alarms and Signals :—

Electric Alarm for Tanks, F. C. Skelton, Montreal, Can., 496,067. Filed Oct. 4, 1892.

Signaling Apparatus, H. Wetzer, Pfronten, Germany, 496,076. Filed Aug. 8, 1892.

For calling stations on a telephone or telegraph system. Employs a series of pendulums, of varying rates of oscillation, at the several stations.

Annunciator, J. H. Elfering. Milford, Conn., 496,192. Filed Oct. 3, 1892.

To select and display any of a number of signals or "wants."

Electric Reporter, M. D. Porter, Brooklyn, N. Y., 496,207. Filed Nov. 27, 1886.

Apparatus for transmitting and receiving indications of a variety of "wants" and identifying the signaling station.

Batteries, Primary :—

Dry Battery, H. Koller, Vienna, Austria-Hungary, 496,228. Filed June 21, 1892.

Plates are composed of agar-agar mixed with a metallic salt. They are separated by insulating perforated diaphragms impervious to water.

Clocks :—

Electric Synchronizer for Clocks, H. S. Prentiss, Elizabeth, N. J., 496,134. Filed May 21, 1892.

Clocks are run slightly fast, and are provided with means for stopping the train automatically at the end of each hour and setting by electro-mechanical means.

Electric Synchronizer for Clocks, H. S. Prentiss, Elizabeth, N. J., 496,135. Filed June 22, 1892.

Similar to the above.

Electric Program Clock, H. C. Hain, Booneville, Mo., 496,258. Filed April 18, 1892.

Conductors, Conduits and Insulators :—

Insulator, J. F. Right, Colorado Springs, Colo., 496,081. Filed Jan. 31, 1893.

Adapted especially for the cross-arms of telegraph and telephone lines.

Distribution :—

System of Electric Distribution, E. Thomson, Swampscott, Mass., 496,020. Filed Dec. 29, 1890.

Mainly an improvement on the system patented to the same inventor, March 29, 1887, No. 360,125.

Electric Converter, W. Stanley, Jr., Great Barrington, Mass., 496,212. Filed Oct. 1, 1887.

Claim 1 follows:

The combination with the primary and secondary coils of a converter, of a core composed of annular laminae of magnetizable material, having inner and outer teeth, the coils being arranged between the teeth upon the core, and laminae of soft iron closing the openings between the teeth outside of the coil.

Dynamos and Motors :—

Combined Dynamo Electric Machine and Water Motor, J. O. Heinze, Jr., Lynn, Mass., 496,307. Filed Oct. 15, 1892.

Designed to employ waste water, in houses, hotels and the like, for the production of electricity.

Electro-Magnetic Reciprocating Pump, C. J. Van Depoele, (deceased), C. A. Coffin & A. Wahl, Administrators, Lynn, Mass., 496,331. Filed Dec. 12, 1891.

The liquid to be moved is passed directly through an electro-magnetic engine. A magnetic plunger is reciprocated.

Electrolysis :—

Method of Electro-Plating Aluminum and its Alloys, G. Wegner & P. Gührs, Berlin, Germany, 496,176. Filed Feb. 3, 1893.

Steeps the aluminum article to be operated on in a bath of acetic verdigris dissolved in vinegar, oxide of iron, sulphur and ammonium chloride; then brushes it with a soft brass-wire brush, rinses it in water and finally subjects it to treatment in an electrolytic bath.

Lamps and Appurtenances :—

Electric Light Display System, D. McF. Moore & C. M. Jacobs, New York, N. Y., 496,366. Filed Nov. 22, 1892.

For presenting words, numerals, or pictures, as desired, by a combination of electric lamps. Sign-board carries a given number of lamps equally spaced in parallel rows, any of which may be lighted from an operating board at a distance.

Electric Arc Lamp, W. H. Akester, London, England, 496,386. Filed Sept. 9, 1892.

Regulating mechanism.

Electric Arc Lamp, W. H. Akester, London, Eng., 496,387. Filed Sept. 9, 1892.

Electro-magnetic regulating mechanism.

Measurement :—

Volt and Amperemeter, J. O. Heinze, Jr., Lynn, Mass., 496,309. Filed Oct. 17, 1892.

Comprises a stationary solenoid to receive the current to be measured, an iron band surrounding the solenoid and having its central portion reduced in thickness at the axis of the solenoid, an iron armature eccentrically journaled within the solenoid and free to swing toward and away from the margin of the tapering depressions in the surrounding iron, a counterbalance and an indicating device actuated by the armature.

Electric Measuring Instrument, R. M. Hunter, Philadelphia, Pa., 496,312. Filed Nov. 16, 1892.

A volt and amperemeter. Employs an expansion wire.

Electric Meter, F. Teague, London, Eng., 496,371. Filed Feb. 2, 1892.

A meter of the type employing a train of wheels. Aims to reduce the speed of the armature and the number of wheels in the train.

Medical and Surgical :—

Electro-Galvanic Adhesive Plaster, F. A. Barrett, St. Louis, Mo., 496,244. Filed Sept. 28, 1892.

Metal Working :—

Electric Soldering, E. Thomson, Lynn, Mass., 496,019. Filed Jan. 22, 1889.

It is particularly applicable to soldering sheets flat-wise. Clamps the pieces together at the seam, passes a current through either or both of the pieces sufficient to melt the solder or uniting metal; cuts off the heating current and maintains the pressure until the joint is cool.

Miscellaneous :—

Electrical Stop-Motion for Knitting Machines, G. J. Manderfield, Royersford, Pa., 496,060. Filed Nov. 25, 1892.

Electric Cigar Lighter, L. T. Smith, Barrington, N. J., 496,101. Filed May 9, 1892.

Employs an incandescing plug or burner-block.

Lineman's Wire-Grip, C. A. Svennsson, Buffalo, N. Y., 496,104. Filed Oct. 28, 1892.

Cut-out and Circuit-Protector, J. O. Heinze, Jr., Lynn, Mass., 496,308. Filed Oct. 15, 1892.

A fuse-wire cut-out.

Coin Controlled Automaton, H. D. Pursell & E. F. Price, Washington Court-House, O., 496,324. Filed Feb. 14, 1893.

Cable-Rack, A. C. Gray, Pittsburgh, Pa., 496,381. Filed Oct. 22, 1888.

For use in connection with telephone exchange switchboards.

Controlling Device for Electric Elevators, O. E. Moore, Boston, Mass., 496,382. Filed June 21, 1892.

A rheostatic device for starting electric elevators gradually.

Railways and Appliances :—

Closed Conduit Electric Railway, W. P. Patton, New York, N. Y., 495,996. Filed July 15, 1892,

Employs a completely insulated conductor near the surface and an exposed longitudinal cover or rail, which latter, being depressed by the passage of a car, actuates contact devices at regular and short intervals.

Electro-Mechanical Block Signaling Apparatus, M. Corrington, New York, N. Y., 496,041. Filed April 26, 1892.

A partially automatic system for railroads.

Electric Railway Trolley, W. W. Pritchett, Ogden, Utah, 496,280. Filed Nov. 2, 1892.

An overhead conductor trolley.

Telpher System, C. J. Van Depoele (deceased), C. A. Coffin and A. Wahl, Administrators, Lynn, Mass., 496,329. Filed May 15, 1891.

Details of construction applicable to the system, patented to the same inventor Feb. 28, 1891.

Electric Locomotive, C. J. Van Depoele (deceased), C. A. Coffin and A. Wahl, administrators, Lynn, Mass., 496,330. Filed Sept. 24, 1891.

Improvement upon the relations set forth in the same inventor's patent No. 448,562, March 17, 1891.

Telephones and Apparatus :—

Mechanical Telephone, G. H. E. Ricke, Cincinnati, O., 496,137. Filed April 15, 1891.

Diaphragm Holder for Telephones, S. W. Holman, Boston, Mass., 496,234. Filed Nov. 5, 1892.

Employs a magnet which tends to deflect the middle of the diaphragm in one direction, and opposing supports with which the diaphragm makes tangential contact only, and which tend to deflect the diaphragm in the other direction.

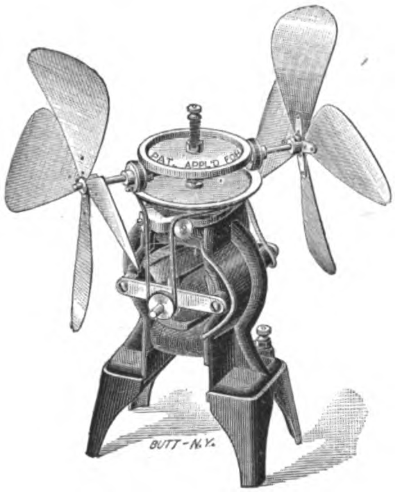
MR. L. H. ROGERS has recently been appointed Assistant General Manager of the Brush Electric Company, Cleveland, O. Mr. Rogers some years since was connected with the Eastern Offices of the Brush Company, when they were managed by S. M. Hamill, the present General Manager of the Brush Company. Subsequently Mr. Rogers became connected with the General Electric Company, of Boston. He moved with his family from Boston to Cleveland, where he will reside. Mr. Rogers was for some years connected with the Electric Accumulator Company, under the Presidency of Theodore N. Vail. He has had a large experience in the electrical business and will be a valuable officer for the Brush Company. Mr. Rogers is well known as the originator and owner of the Mt. Washington Search Light which he placed on the summit of the Mountain during the Summer of 1892, and which was fully described and illustrated in THE ELECTRICAL ENGINEER exclusively. He has recently been experimenting with this search light with a view of throwing intelligible words and characters long distances. He has succeeded in utilizing the clouds for a screen, and a company is now being formed for the purpose.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE DE MOTT "TURRET" FAN MOTOR.

THE little electric fan outfits first looked upon as a luxury have now come to be considered as necessities, and have been introduced in large numbers wherever electric current is available. The only reproach which has been raised against them in the past has been that the air current emanating from such fans was directed to a single spot. To obviate this difficulty a number of devices have been introduced, one of the most ingenious of which is that shown in the accompanying illustration, which represents the De Mott "Turret" fan motor.



THE DEMOTT TURRET MOTOR.

As will be seen the motion of the armature is transmitted by a round belt to a revolving turret placed above the motor. This turret carries a spindle upon which the fans are mounted, and which are kept in motion by friction wheels resting on the turret. The result of this arrangement is that while the fans revolve rapidly they are also made to turn in a horizontal plane, and hence distribute the breeze uniformly in all directions. The fans revolve at a speed of 1,200 to 1,500 revolutions per minute.

The outfit is designed to be run with a battery giving from six to eight volts, and weighs complete about six pounds. With such extreme lightness, and requiring only three to five cells for its operation, the fan is eminently adapted for the ventilation of the dining-room, parlor and bedroom.

The outfit is now manufactured in various styles of finish by the De Mott Motor & Battery Company, No. 15 Cortlandt street, New York. We have had the motor submitted to us for inspection, and find it beautifully built and finished in a most admirable manner.

ENTIRELY UNDER MR. FRED. SARGENT'S SUPERVISION.

THE above heading alludes to the extensive improvements and extensions now being made in the several large lighting stations of the Chicago Edison Company. Mr. Fred. Sargent, who for some time has been acting as consulting engineer for the Chicago Edison Company, has, since his resignation as Chief Mechanical and Electrical Engineer of the World's Fair, been occupying his time partly with the new construction work of that growing corporation; and it is understood that he has now taken entire charge of the construction of the new Edison stations located on Harrison street and also on the North Side, besides the doubling of the capacity of the South Side station. These extensions involve in all the installation of upwards of 12,000 h. p. This is probably the largest work of its kind ever undertaken by one company and at one time. The entrusting of such a work to Mr. Sargent shows what implicit confidence so large a company as the Chicago Edison Company must have in his ability as an engineer. The consolidation of the Chicago Edison Company and the Chicago Arc Light & Power Company is now complete and the combined business, as already stated in THE ELECTRICAL ENGINEER, will hereafter be known under the name of the Chicago Edison Company, the capital of which is $3,000,000 of stock and $2,250,000 of 6 per cent. debentures. As an evidence of the wonderful growth of the business of The Chicago Edison Company and the necessity for the building of very large stations and the doubling of the capacity of those already in operation, it may be said that the company shows an increase for the first three months of this year and of 1893 exceeding 40 per cent. This showing is made without taking into consideration the business of the Chicago Arc Light & Power Company. The information is given that the large station being erected for the Company on Harrison street will be in full operation in the month of August. Without doubt the work undertaken by Mr. Sargent, when completed, will stand out boldly as a creditable monument to his skill as a mechanical and electrical engineer. Mr. Sargent's position in the work described above will in no way whatever affect his connection with the well-known firm of Sargent & Lundy, representatives in the West of the McIntosh & Seymour Engine Company and also well-known to the trade as electric railway contractors and engineers.

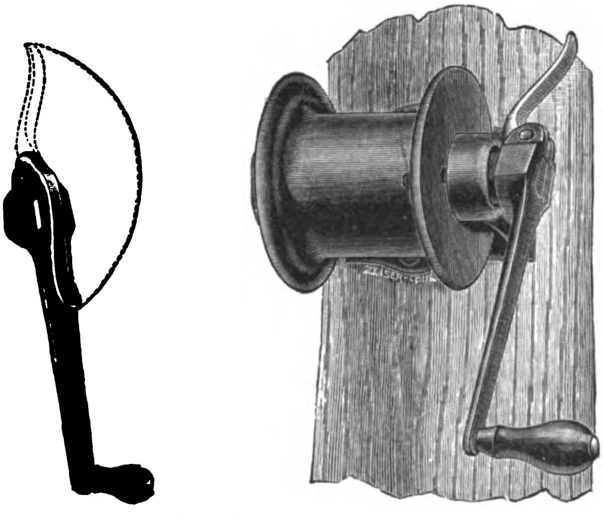
THE EDDY SELF-LOCKING WINDLASS.

IN the raising and lowering of arc lamps for the purpose of trimming, use is made of a windlass which generally has had to be locked and unlocked with a key in order to maintain the lamp in position and to lower it for trimming, respectively. This operation not only consumed the time of the trimmer, but it subjected the lamp to the danger of running down entirely, and thus being damaged. To avoid these inconveniences, the Eddy self-locking windlass has been designed, which is shown in the accompanying illustrations.

Fig. 1 shows the position of the crank and tongue when the windlass is unlocked, and Fig. 2, when locked. As will be seen the putting on and taking off of the crank unlocks and locks the windlass automatically, and obviates all necessity for a key, as well as economizing the trimmer's time.

It is evident that the windlass cannot be left unlocked, for when it is in position it is impossible to remove the crank without locking the windlass; besides, the trimmer has entire control of the appliance with the use of one hand, and the arrangement can be locked in any position.

The construction of the windlass is such that there are no openings left unprotected for the lodging of sleet, etc., so that it is at all times ready for use; as the windlass can only be locked and unlocked by attaching the crank, it is therefore as safe and secure as though fastened with a padlock and key. The windlass is made of practically three castings, and has no small and intricate parts to get out of order.



FIGS. 1 AND 2.—THE EDDY WINDLASS FOR ARC LAMPS.

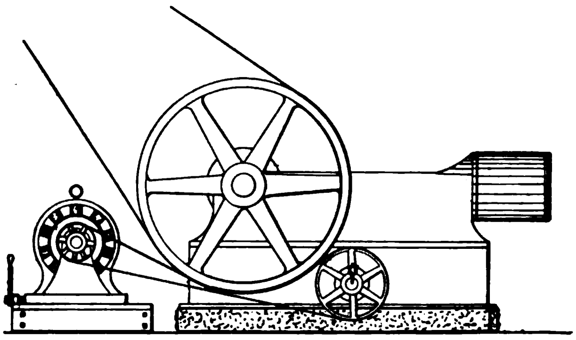
This handy device is placed on the market by Mr. S. E. Whitehead, of Carthage, Mo., who is sole agent for the United States.

ST. LOUIS NOTES.

THE AMERICAN ELECTRICAL MANUFACTURING COMPANY of St. Louis, manufacturers of incandescent lamps, whose factory has been closed for some months, will resume operations at once and Mr. Nahm, secretary and treasurer of the company, informs THE ELECTRICAL ENGINEER'S correspondent that they will commence operations with their capacity fully doubled. The favorable decision in the Columbia Incandescent Lamp Company's case which enabled the Columbia Company to again operate their large factory and the resuming of business by the American Electrical Manufacturing Company, St. Louis, will offer excellent possibilities for those requiring incandescent lamps.

NEW FORMS OF THE "L., P. & D." TRANSMITTERS.

We illustrate in the three accompanying engravings some new designs of the L., P. & D. Transmitter Company, of Montpelier, Vt. The L., P. & D. transmitters have been on the market for transmitting power from engines or shafting to dynamos for the past two years, and have achieved such success that the company have adopted some further methods for varied applications of the power. Fig. 1 shows a side view of the L., P. & D system applied direct to engine bed or foundation as put on by engine builders under license from the L., P. & D. Transmitter Company, and also shows the engine engaged in driving, by the old way of belting machinery on the floor above, and driving a dynamo on the same floor as the engine, by the L., P. & D. system. This system, as will be observed, does not require any special apparatus beyond that furnished by the L., P. & D. Company, consisting simply of a pulley fastened to the engine, around which the belt passes which transmits the power to the dynamo, and not interfering in any way with the power which the engine may be transmitting by direct belting to any other machinery.



SIDE VIEW SHOWING TRANSMITTER ON ENGINE BASE.

Fig. 1.—L., P. & D. Transmitter.

This method of driving dynamos, which is quite new, may be seen in operation in the Hotel Lakota, Chicago, where a number of dynamos are being driven direct from the engine with perfect success.

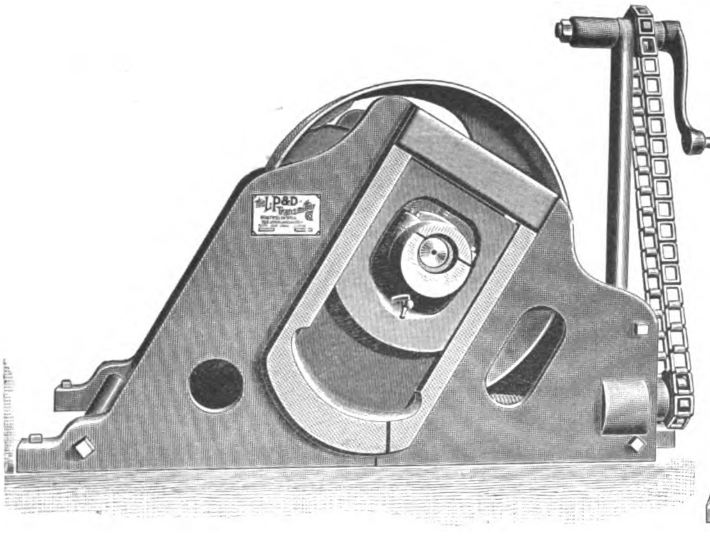


Fig. 2.—Class "B" Transmitter.

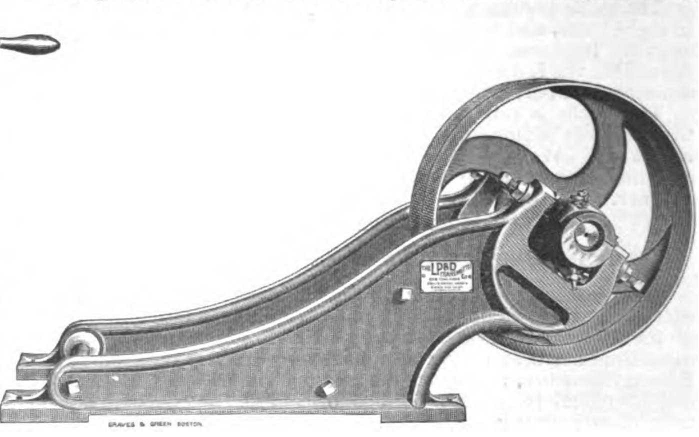


Fig. 3.—Class "C" Transmitter.

The regular transmitter of the L., P. & D. Company is already well-known to our readers and we illustrate in Figs. 2 and 3, two new types of transmitters, which the company have designed after a long experience with those of their first design. Fig. 2 shows their class "B" transmitter which is very rigid and substantial, has ring-oiling bearings and is built in every way to withstand the severe work of driving dynamos and railroad generators. It is recommended for every place as a well-made and satisfactory working machine. Its pulley is raised and lowered by means of sliding wedges under the frames supporting the boxes, which are operated by means of screws, link belting, and crank, as shown in the figure. This class is made to carry belts from 8 to 12 inches wide, as regular sizes; and larger sizes can be made to order. Fig. 3 shows their class "C" transmitter which is also a rigid and smooth running machine and sets somewhat lower down than the class "B", described above. It has the same style of ring-oiling bearings and is designed to meet the want of a lower-priced machine. With all these new transmitters, the dynamos can be moved to start and stop by simply raising the pulley until it tightens the belt on the driving pulley of the engine or countershafting, in the same manner precisely as their former transmitter. They are, however, of more substantial manufacture than the old form, of more lasting qualities, and are simpler to operate. They occupy but very little space on the floor and many of them are in actual operation with perfect success. There have been numerous methods of transmitting power to dynamos put on the market and used, with more or less success, but it can be confidently stated that the L., P. &. D. system wherever it has been installed has been perfectly successful and is well worthy the careful attention of all electrical engineers who are engaged in designing stations. They will be found to be not only economical in the matter of saving space, but also in the matter of the power consumed.

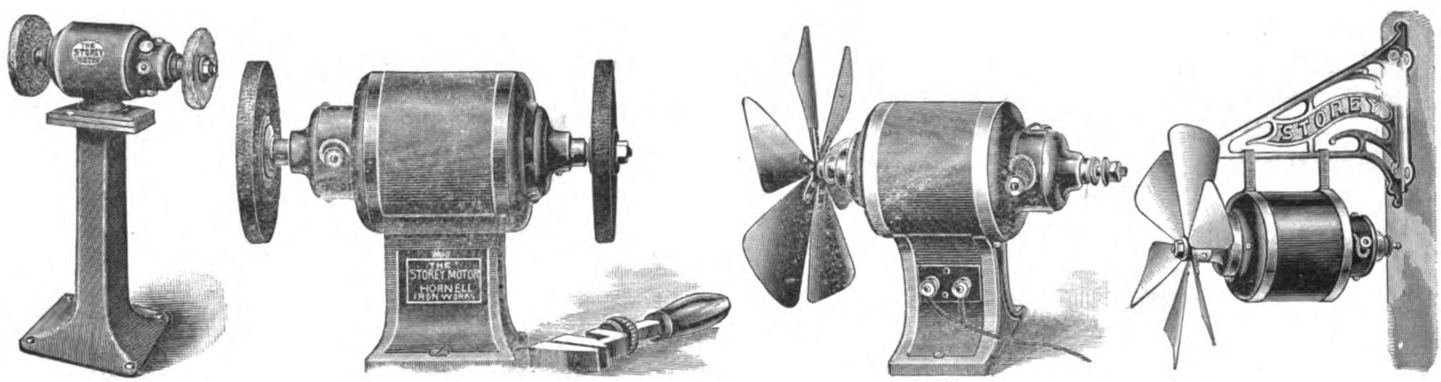
THE "COLUMBIAN CELEBRATION" IN ST. LOUIS.

Coincidal with the fortunate Columbia Incandescent Lamp Co.'s favorable decision, we might say St. Louis had last week a Columbian Celebration. The decision in favor of the Columbia Lamp Co. in its suit with the General Electric Co. attracted a great deal of attention in St. Louis. The full text of the decision has already appeared in The Electrical Engineer. President Rhotehamel is entitled to great credit, and it is conceded by everybody interested that but for the untiring efforts and energy put forth by Mr. Rhotehamel, a decision entirely different to the one rendered would have been the result. The collection of evidence necessitated Mr. Rhotehamel's making a number of trips to New York and other cities, and it may be said he spent night and day, never flagging in his energies, to bring about the achievement of just what happened on Friday morning last. President Rhotehamel is, to say the least, greatly elated over his success, and is perhaps one of the happiest men in St. Louis to-day, feeling as he does, that his untiring efforts in behalf of the Columbia Lamp Co. have been crowned with success. Congratulations and telegraphic lamp orders have been fairly showered upon him. The company resumed operations this week with their forces somewhat depleted, thereby reducing a little for a while the daily output of the factory as compared with that enjoyed at the time of its shutting down. This was occasioned by some few of the operatives straying from the fold when the factory was idle. The company are having very little trouble in securing all help necessary to operate their entire factory, and judging from the way orders were pouring in for the two or three days immediately following the decision, it will be necessary for the company to work both night and day. Upon inquiring of Mr. Rhotehamel his opinion as to the judges requiring the filing of a bond, he said, that he was "well pleased with it," as the very fact of the company being compelled to file this bond meant a positive protection to all customers agaiust any possible claims for royalty. The policy of the company will be to maintain a reasonable price for the goods that they manufacture. President Rhotehamel is especially well pleased with the way the counsel handled the case from the start. The St. Louis counsel were Judge E. B. Adams and Mr. C. E. Fowler, of the firm of Fowler & Fowler. The counsel at the New York end were Messrs. Witter & Kenyon. It is unnecessary to comment on Mr. Kenyon's work, it is already known.

Mr. Madison Buell has a most interesting and beautifully illustrated article in the *Buffalo Express* of April 16, on all the latest work and inventions in electricity.

THE STOREY DIRECT-DRIVING MOTORS.

THERE can be no question of the great advantages of direct driving with motors in a large range of mechanical operations, but it is not until of late that any marked success has been attained in this respect. THE ELECTRICAL ENGINEER, of March 15, illustrated and described some of the inventions of Mr. I. E. Storey along this line, and it now has the pleasure of calling attention to some further developments of his ideas. It will be remembered that in his "Solenoid" motor, Mr. Storey produced a machine hermetically sealed, and free therefore from dust, moisture, and external injury; while the containing shell forbids any accident to surrounding persons or objects should trouble chance to occur inside. Our article showed the application of the motor to a 12-inch drill.


THE STOREY MOTOR
THE STOREY MOTOR HORNELL IRON WORKS
STOREY

STOREY MOTORS USED FOR GRINDING, BUFFING, FAN WORK, &c.

The Hornell Iron Works, of Hornellsville, N. Y., which are now bringing out these motors under the supervision of Mr. Storey, have just placed some other ingenious forms of this "motor combination" on the market. One of them, illustrated on this page, is the 2 h. p. Storey grinding and buffing motor for factory and electro-platers' use. Another is the ¼ h. p. grinding motor for machine shop use. It is very easy to slip off one of the emery wheels, and substitute a buffer, when the tool is at once ready for jewelers and fine metal workers. The same style of outfit is shown in the ⅛-h. p. fan motor for desk and table use in offices, hotels, etc. But a still more striking use of it is seen in the bracket fan motor, which, as shown, can be fixed up at any point to deliver its grateful breeze. Very often it is a difficult thing to find a place for the fan motor, but this bracket adds greatly to the choice and range of available position. All the motors have carbon brushes, and are therefore in little need of attention. Sizes from ⅛-h. p. up to 2-h. p. are now ready in 110 volt windings, and sizes from 1 up to 10 h. p. are also being made for 220 and 500 volt circuits.

The Storey motor is also being applied to electric launch work, for which its peculiar form adapts it admirably. The screw is placed right on the armature shaft. The motor is so boxed up in its iron jacket, that it will run in water without trouble, and hence is very useful for launch work in all weathers.

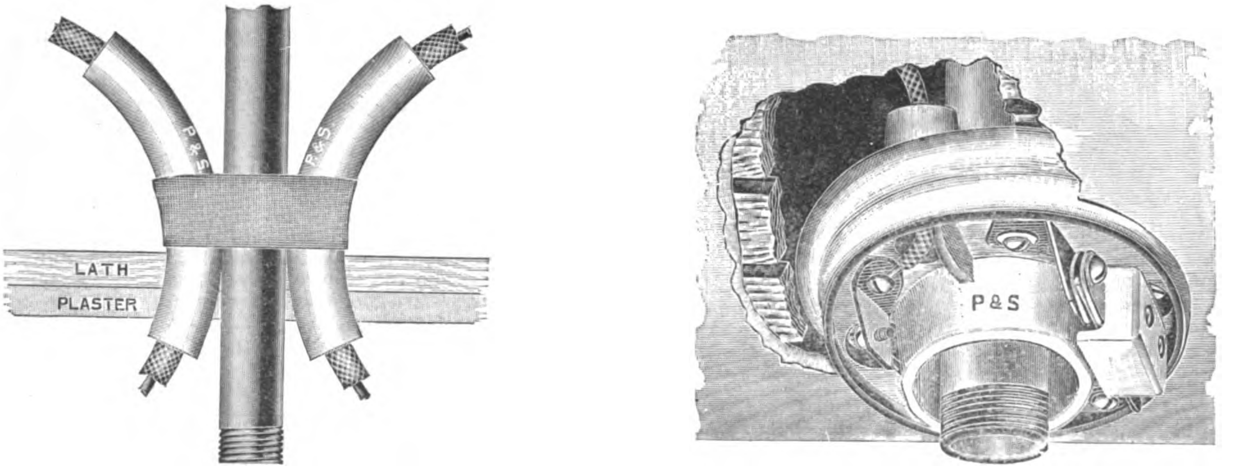
The Dahl Electric Company, of 120 Liberty street, New York City, are the agents in the Eastern and Middle States for the manufacturers.

THE "AJAX" DRY BATTERY.

AMONG the dry batteries, there is perhaps none better known than the Ajax Dry Battery, improved, manufactured exclusively for the Ansonia Electric Company. This battery still wears the familiar red jacket with a cut of Ajax defying the lightning, and the fact that it has now been on the market for about four years and that the sales are continually increasing, is a sufficient testimonial to its sterling value. This firm has recently turned out a colossal Ajax Dry Battery for exhibition at the World's Fair, which is actually alive and will give a current of six volts and seven amperes. Its dimensions are 30 inches high by 12 inches in diameter and it will be a familiar sight to visitors in the Electrical Building.

P. & S. COMBINATION FIXTURE CUT-OUT AND OUTLET INSULATOR.

THE proper insulation of outlet wires has been difficult. The wires are liable to be displaced by the lathers and plasterers, and in many cases leakage occurs through the plaster to the gas pipe on account of defective insulation. As the inspector can only see that part of the wires which projects through the plaster, he has to "trust to luck" for what is out of sight. To overcome these difficulties Pass & Seymour have devised a combination fixture cut-out and outlet insulator. As will be seen by the cut, it is fastened to the lathing, and when the plaster is put on, the cut-out projects slightly through it. The wires pass through holes in the china plate, and it is impossible for them to touch the gas pipe or the lath or plaster. It is fitted with brass work for connecting the wires or fuses, and is furnished either with fuse plugs which cover the fuses, or may be fused in the ordinary way.

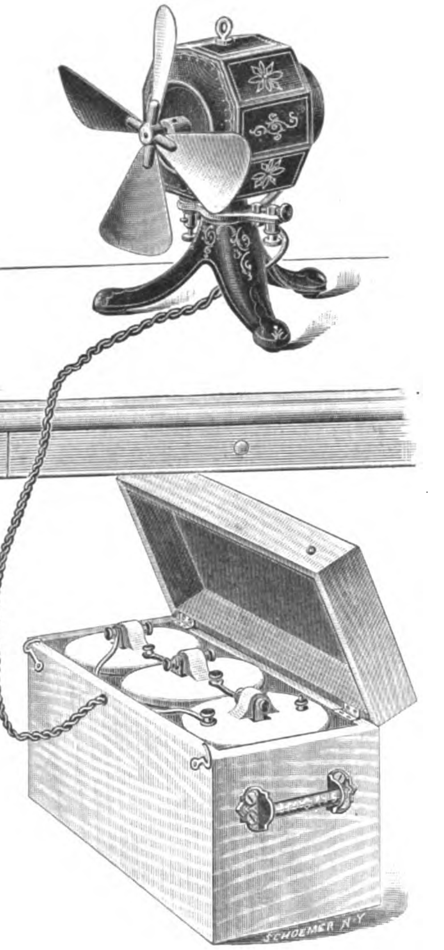


FIGS. 1 AND 2.—P. & S. COMBINATION FIXTURE CUT-OUT AND OUTLET INSULATOR.

Pass & Seymour also make small curved-china tubes for outlets which effectually insulate wires from the gas pipe and lath and plaster. They are fastened to the pipe with tape in the usual way, as shown in the cut. Unlike the tubing made of fibre, and the various compounds, the china insulators cannot be bent out of shape, nor do they deteriorate with age, are not affected by the plaster, are impervious to moisture, are absolutely fire-proof and of exceedingly high insulation.

THE EDISON MANUFACTURING COMPANY'S NEW IRON-CLAD BATTERY FAN MOTOR.

THIS fan motor has been designed with especial reference to primary battery operation. The friction of its armature bearings and brushes has been reduced as far as practicable, and it runs a 7-inch four-bladed fan at 1,000 revolutions per minute with 2.0 amperes and 1.5 volts at the terminals. This gives an almost noiseless delivery of steady breeze for table or desk use, and its presence will be very welcome during the approaching warm weather. The battery consists of three Edison-Lalande Q cells in an oaken box. The capacity of one charge in this battery is 150 ampere-hours, with practically no loss from local action when the motor is out of use. By this means, the battery will last 10 weeks without renewal at one hour's work daily, or 10 days at a steady operation of 7½ hours per diem. For the parlor or dining table, the fan is an attractive ornament, while at the bedside, either on a table, or suspended from the wall, it is a most agreeable companion, for it is so nearly silent, that it lulls rather than disturbs, and the breeze streams through its spinning blades, laden with cool and refreshing slumber. It will not drop grease on the tablecloth or carpets, for its bearings are self-oiling, and carry on their own lubrication without loss or rejection of the lubricant, while the oil in the wells needs only to be changed whenever the battery is recharged.


SCHOEMER N.Y.

THE EDISON FAN MOTOR AND BATTERY.

The armature is, as the motor's name suggests, entirely enclosed in an iron box or ornamental field frame, with a glass window on one end through which the brushes and commutator can be inspected. This arrangement combines all the advantages of an ironclad motor as to compactness, safety, noiselessness, cleanliness, efficiency, etc., with the particular and novel feature of leaving the brushes always open to examination. To remove the glass window and readjust or replace a brush after months of wear is only the work of a few moments, and the plan adds greatly to the convenience, simplicity and finish of the machine.

For country villas, city residences, business offices, steamer cabins, etc., the fan will be in great demand during the Summer weather. The battery box only occupies 18¾ x 7 inches x 9¾ inches and can therefore be always accommodated without inconvenience. The price of the motor with fan and switch is $8.00 or with battery and one charge $15.50. Each complete recharge of the battery for a fresh term of 75 running hours costs $2.07, so that after the first purchase and recharge, the cost of operating the machine amounts to 2¾ cents per hour. This is on all hands admitted to be a most economical and satisfactory performance. The Edison Manufacturing Company of 110 East Twenty-third street, New York, are the sole manufacturers.

MANY ORDERS FOR BALL ENGINES.

THE BALL ENGINE COMPANY, Erie, Pa., report the following recent shipments, and state that their already large capacity is overcrowded with work: Western Light and Power Company, Chicago, Ill., one 300 h. p. simple engine; Thomson-Houston Electric Light and Power Company, Quincy, Ill., one 350 h. p. cross-compound engine; Ann Arbor, Mich., Electric Light Company, one 300 h. p. cross-compound engine; Alameda, Cal., Street Railway Company, two 150 h. p. tandem-compound engines; Tampa, Fla., Street Railway Company, one 200 h. p. cross-compound engine; Water, Light and Power Company, Nebraska City, Neb., one 100 h. p. tandem-compound engine; Niagara Falls, N. Y., Street Railway Company, one 130 h. p. simple engine; Pennsylvania Salt Manufacturing Company, Natrona, Pa., one 70 h. p. simple engine; Shoenberger & Co., Pittsburgh, Pa., one 80 h. p. simple engine; Gallatin Light, Power and Railway Company, Bozeman, Mont., one 150 h. p. simple engine; Hotel Plaisance, World's Fair, Chicago, one 100 h. p. simple engine; F. W. Wheeler & Co., electric lighting on steamers, three 25 h. p, simple engines; Cienfuegos, Cuba, one 60 h. p. simple engine; Everett, Wash., Street Railway Company, one 200 h. p. cross-compound engine, one 150 h. p., and one 125 h. p. cross-compound engines; Intermountain Electric Company, Salt Lake City, Utah, one 130 h. p. simple engine; W. H. Kiblinger, Auburn, Ind., one 125 h. p., simple engine; Cohasset, Mass., Electric Company, one 80 h. p. simple engine.

TRIAL TRIP OF THE INTRAMURAL RAILWAY.

AN informal opening of the World's Fair Intramural Railway took place last Thursday afternoon, when the first trial trip was made around the entire track. Four cars constituted the train and held about a hundred passengers, consisting of the officers of the road and their guests. With the exception of the waits at each station to allow carpenters to saw away enough of the platform to let the train pass, the trip was successful and highly enjoyable. There will be no formal opening of the road, but a train will immediately commence to make regular trips without more ado.

Much has been, and is still being, written about this road and its power house, but as it is even yet not quite complete, and as changes are constantly being made in the electrical and mechanical details, a great part of the information published is necessarily inaccurate and imaginary, besides being without the sanction of the engineers. When the matter is ready for publication, it will appear in the columns of THE ELECTRICAL ENGINEER.

NEW YORK NOTES.

MR. ARTHUR BERGTHEIL, A. M. I. E. E., of the firm of Bergtheil & Young, electrical engineers, inventors, etc., of 18 Walbrook, E. C., London, Eng., whose advertisement will be found in this issue, sailed from London for this country April 26th, on the steamer "Germanic." The object of his visit is to attend the Chicago Exposition and to personally investigate while here American electrical specialties for introduction into the English market.

MR. CHAS. D. SHAIN, of 136 Liberty street, has added to his agencies, the selling department for the Cutter Electrical Manufacturing Company, of Philadelphia, for this vicinity. He will therefore handle the Cutter push-button switches, push switches and other standard goods and novelties.

MR. FREMONT WILSON, the electrical engineer and insurance expert, has removed his office to Room 1,111, Vanderbilt Building, 132 Nassau street. He is making a specialty of insurance surveys, and is doing some very useful work in this field.

MR. L. E. WHICHER.—The engagement has been formally announced in Boston, of Mr. L. E. Whicher to Miss M. Brausen, of Cincinnati. Mr. Whicher is a director of the Beacon Vacuum Pump & Electrical Co., and has been its treasurer since its formation. He is also a member of T. A. Whicher & Co., one of the oldest and largest shoe manufacturers in the world. The engaged couple have been busy receiving the congratulations of a host of friends.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.
Vol. XV. MAY 10, 1893. No. 262.

ELECTRICAL ENGINEERING PLANT AT McGILL UNIVERSITY.

THE new buildings of applied science at McGill University, Montreal, are lighted throughout by the electric light, the lighting station being an essential part of the electrical engineering laboratories.

The plant consists of two 30 k. w. dynamos, a Siemens and an Edison-Hopkinson, shown in Fig. 1; each is compound wound for 105 volts at 460 revolutions. The dynamos are driven by two 60 h. p. Willans engines; they are coupled direct, no flexible coupling being used, the whole being on one bed plate.

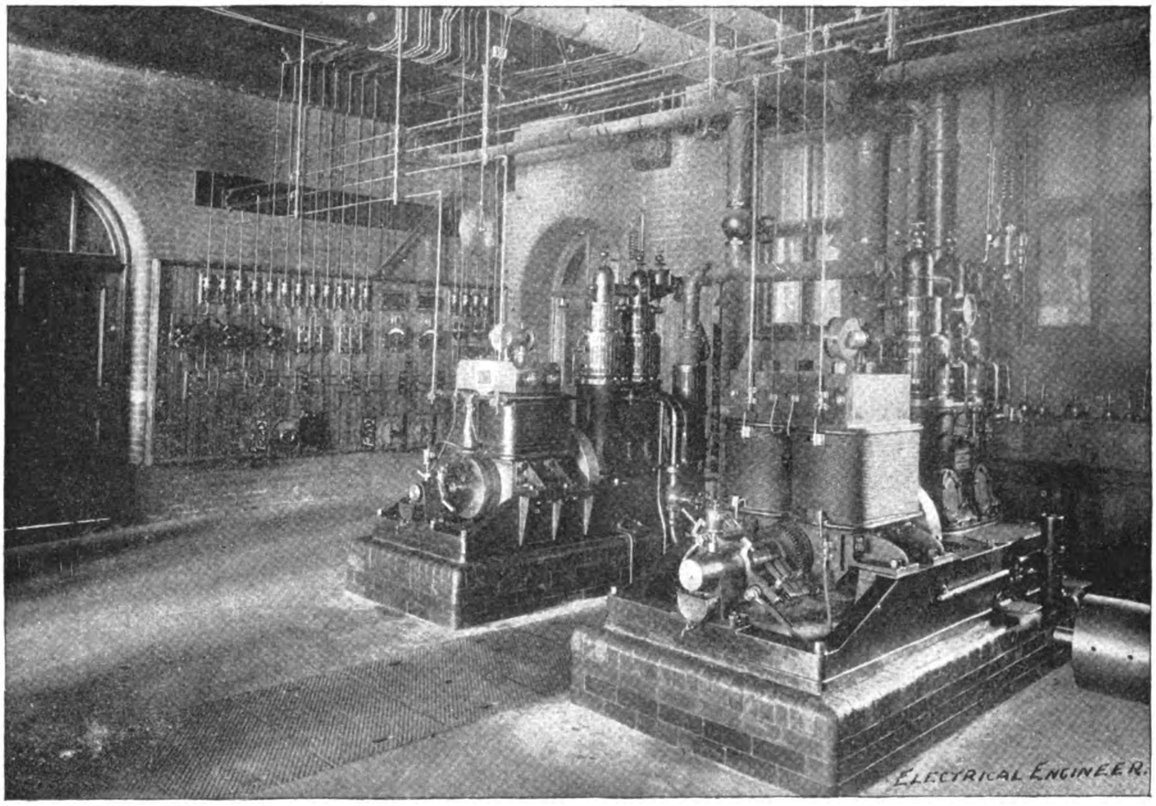


FIG. 1.—DYNAMO PLANT, ELECTRICAL ENGINEERING DEPARTMENT, McGILL UNIVERSITY, MONTREAL, CAN.

The engines are each double compound tandem single acting. The piston rods are hollow, and contain the piston valves which are operated by independent eccentrics. The cushioning is effected by a cylinder formed of the cross-head guide, providing a third cylinder below each tandem pair occupied by air only; as the cranks are set at 180 deg., the air in one cylinder is fully compressed when the air in the other is at atmospheric pressure; the result is that there are two elastic cushions of air producing a remarkable smoothness of running. As the engines are single acting the thrust on all the bearings is always in the same direction, and is never reversed; there is consequently an entire absence of knocking.

The bed plate is utilized as a lubricating reservoir, the cranks splashing up the oil as they revolve, and thus lubricating all the parts in the crank chamber; the only other oiling required is that by the sight feed above the steam chest. Steam is supplied by two 60 h. p. Babcock boilers.

The engraving, Fig. 2, shows the main switchboard. The connections are arranged so that the lighting circuit may be run either on the three-wire system with the two dynamos in series, or on the two-wire system—the positive and negative being coupled—by either one of the two dynamos (they cannot be put in parallel), or by the accumulators. The left hand two-way switch throws the load on the top bus-bar either on to the Edison-Hopkinson machine or on to the bottom bus-bar—in the latter case cutting out the Edison-Hopkinson machine and running the whole load two-wire off the other dynamo. Similarly the centre two-way switch throws the load on the bottom bus-bar either on the Siemens machine or on to the top bus-bar; so that when running three-wire all the load on one machine can be switched over on to the other and run two-wire; or, when running two-wire the load can be changed over from one machine to the other. Thus after a run on full load with the machines in series, when the total output comes down to that of one machine the lighting circuit is run two-wire on one machine and the other shut down; when the load has further diminished, and can be carried by the accumulators, the third two-way switch is thrown over, connecting the neutral bus-bar to the accumulators, at the same time disconnecting it from the common neutral of the dynamos.

The main circuits to the Engineering and Physics buildings, carrying 1,200 and 500 16-c.p. lamps, respectively, are operated by two double-knife switches. The latter building being 400 yards distant, an equalizer is introduced into the positive lead, and a two-way switch passes the whole current through the equalizer whether as the building is being lighted on the two or on the three-wire system.

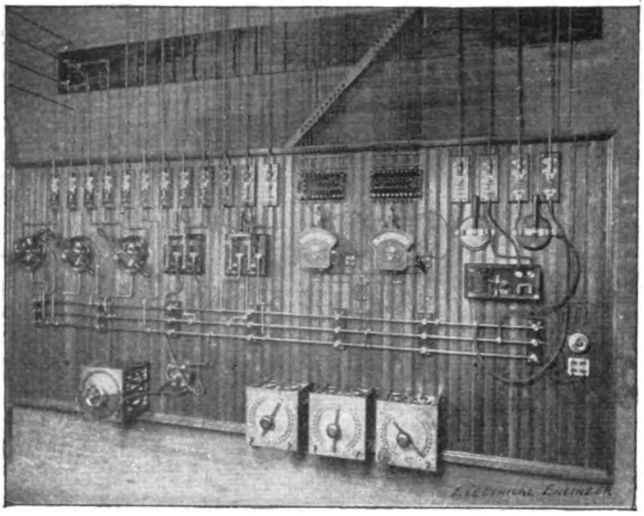


Fig. 2.—Main Switchboard, Electrical Engineering Department. McGill University.

The accumulators are charged by a 12 k. w. Edison dynamo driven by a 12 k. w. Edison motor; the current for the latter passes through the switch on the extreme right of the switch board; the charging current passes through the adjacent switch and also through the automatic cut-out just beneath it. The charging current is regulated by a rheostat placed in the fields of the charging dynamo—the left hand one of the three rheostats shown together.

Fig. 2 shows the circuits of both buildings being run by the Siemens machine, and the accumulators being charged. The three rheostats are in the shunt field circuits of the two lighting dynamos and the charging dynamo.

The currents passing in the various circuits are measured by the fall of potential in the $\frac{1}{2}$-inch copper rods connected with the switchboard: Two wires are fastened by solid brass terminals to two points on each circuit and are carried to an upper and lower terminal on a slate base; two brass springs slide to and fro on two steel rods and make a good contact with these terminals, thereby connecting each pair successively with a voltmeter which requires 30 millivolts for a full scale deflection. In this way one instrument serves to measure the current passing through as many as nine different circuits. There are two scales, one reading to 400 amperes and one to 80 amperes; the latter is used on those circuits—as on that for charging the cells—in which greater accuracy is needed with a smaller current; all that is needed is to place the terminals further apart to get the same drop with the smaller current.

The voltmeter is fitted with a similar sliding commutator for measuring the voltage on the various circuits—including that on the lamps in the Physics Building—by means of pressure wires.

The scales of these instruments are transparent, and a lamp burns behind, clearly illuminating the scale which can thus be read at a considerable distance.

All the switches, fuse blocks, etc., are on slate. The two-way switches are by Messrs. Drake & Gorham; the knife-switches by the Thomson-Houston Company; the indicating instruments by the Weston Electrical Instrument Company; the rheostats by the Crocker-Wheeler Electric Company; the fuse blocks, sliding commutators, bus-bars, and all connections were made in the College workshops, the copper being supplied by the Eureka Tempered Copper Company.

We are indebted to Prof. Chas. A. Carus Wilson, in charge of the Department of Electrical Engineering at McGill University, for the above details and the photographs from which our illustrations are made.

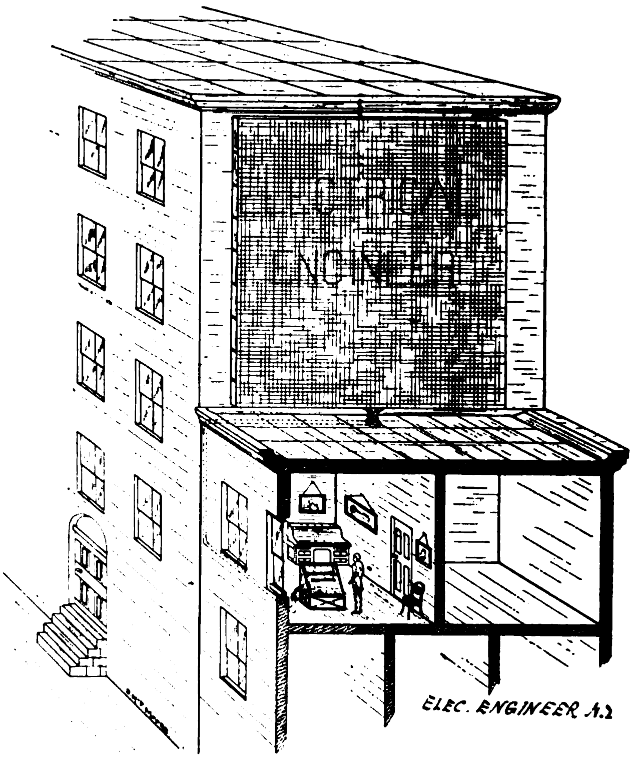
THE JACOBS AND MOORE ELECTRIC DISPLAY SYSTEM.

BY

D. McFarlan Moore

Experience proves that the most successful inventions are those which concern the largest number of people, and that anything of a public nature will have a general interest. Nothing is more of a public nature than advertising, and to effect the greatest result by this means there has been devised an improved system for illuminating and constructing signs, consisting of lettering, sketches or designs of any description or size whatever and to be used either for indoor or open-air use.

Over any given surface, incandescent lamps are arranged at equal intervals in horizontal and vertical rows equally spaced and as closely together as advisable. Each of these lamps is electrically connected with an operating board, placed at any suitable distance, and consisting of the same number of circuit closers as there are lamps and arranged in an exactly similar manner The face of the operating board is therefore covered with push-buttons placed as closely together as possible. It will be readily seen from the accompanying illustration that simply by writing or draw-



Jacobs and Moore's Electric Display System.

ing on the face of the operating board any effect desired can be produced on the sign in a greatly enlarged scale.

For comparatively small signs miniature incandescent lamps can be used. A merchant will then be able to attract attention to his show windows by the use of the most brilliant form of illumination known, and at the same time change the form of the attraction as often as he desires. By a movement of the lever at the side of the operating board, which will take up no more room in the store or office than the typewriter does, the push-buttons or circuit-closers are released and an entirely new design can be produced. It is not necessary that the operator see the sign because with a bright light behind the operating board and the push-buttons slightly conical in form, an exact fac-simile of the sign is produced on the face of the operating board.

For night work the bulletin boards now used by the great newspapers can be replaced by "boards" of this system so that the telegraph operator can immediately write his messages for the public eye.

What are usually called "chalk talks" are practicable with this system in the open air. They can combine advertisements with comical sayings and illustrations, political campaign matter, instructive data and sketches of noted men and scenes. For the publication of election returns, results of foot-ball games, pugilistic contests, etc., or any matter of public interest, this system will be of great utility as it will display them by the use of the best and most attractive means known to modern science—the electric light. When the great cost of the large number of signs being erected, which consist of definite, permanent characters, is taken into consideration, it will be seen that the salient point of this system is its absolute freedom and flexibility.

Each night the "artist" or operator can be changed so that different personalities will show forth, as the writing can be of any style or language, and the sketching of any size within the limits of the sign. It will also be possible to reproduce the same sketches in different parts of the country by simply numbering and recording the push buttons required to produce certain effects.

Again with either large or small signs there will be a certain, and a powerful attraction in watching the signs being "made up" by an invisible operator. It is well known and has been noted by many prominent men, that there is nothing which so completely rules the American people as their curiosity; therefore when they see a word or sentence or picture half completed—nine out of ten will wait to see the whole. The results can be produced instantly, however, by using a "stencil" or throwing the switch after the illustration is made up.

The site chosen for an installation of this character should be the most advantageous obtainable. In many cities or towns the whole side or part of a conspicuous building will be most suitable. It could be rented by the hour, day or week, according to circumstances.

Complete plans have been prepared for an installation of this nature, in New York City, consisting of about 8,000 16 c. p. lamps placed at great centres and covering a wall 60 x 70 feet.

ELECTROLYSIS BY ALTERNATING CURRENTS.

Signor Ricardo Malagoli (announces the *Bulletin de l'Electricité*) has established that the necessary and sufficient condition under which the phenomenon of electrolysis by alternating currents is possible, is that the quantity of electricity which traverses the voltameter during a single alternation of current is greater than double that which is required to produce the maximum polarization in the voltameter. The electrolytic production ceases when these two quantities are equal, and the quantity of electrolyte decomposed is proportional to the difference of these two quantities.

THE CONDENSER IN ALTERNATE CURRENT POWER DISTRIBUTION.—II.

BY

William Stanley Jr.

If we examine a practical case applying the above calculations and compare the ampere-turns required for the iron portion of the magnetic circuit with the ampere-turns required for the air-gap portion, we are sure to find the ampere-turns required for the air-gap to exceed those necessary to magnetize the iron; or, in other words, that while only a comparatively small current flowing about the coil is required to flux the iron, without an air gap, a much greater current has to occupy the coil to force the magnetism from the pole faces across the high resistance air slit. Imagine the current required for the magnetization of the iron to be .5 ampere and that 10 amperes is needed to flux the air slits; it is desirable to know the absolute and relative watts wasted in the two portions of the magnetic path and also the relation of these values (watts) to the volt-amperes of apparent energy.

We know that in the magnetization of iron cores by alternate currents we have certain losses due to hysteretic and Foucault actions. These losses can be exactly ascertained either by wattmeter or other measurements, or they may be calculated. It is not necessary to dwell on their estimation, more than to say that the actual losses in cores subjected to alternate magnetization in practical work never equals the apparent loss. Thus if 500 volts (alternating) are applied to the terminals of a magnet made without air slits the energy apparently lost in the iron core would be 500 (volts) × .5 (amp.) = 250 volt amperes, but if the readings of current and E. M. F. were measured by a wattmeter the watts would be found to be less than the volt-amperes so that to reduce voltamperes to watts it is necessary to multiply the product of the volts and amperes by a decimal coefficient which we may call the watt or work factor. In endeavoring to estimate the watts accompanying the magnetization of the air slits in the case assumed, we multiply the applied volts (500) by the magnetizing current for the air gap, or (10) amp., = 5,000 volt-amperes by the watt coefficient. There is, however, no real energy waste, in magnetizing air, only an apparent expenditure of energy, for wattmeter measurements fail to give any watt value for the volt-amperes; that is to say, so far as experiment can be made, there is no sensible energy expended in forcing the magnetism across layers of air interposed in a magnetic circuit, as the volt-amperes necessary to flux the circuit have to be multiplied by a zero watt coefficient; and so we see that whenever we try to magnetize a magnet by alternate currents, such a magnet, for example, as must be used in an alternate current motor, especially one in which

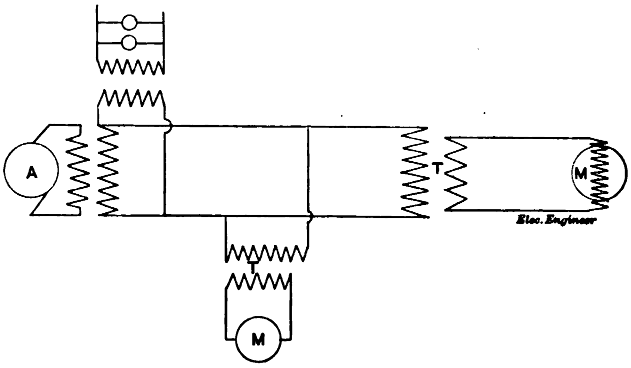
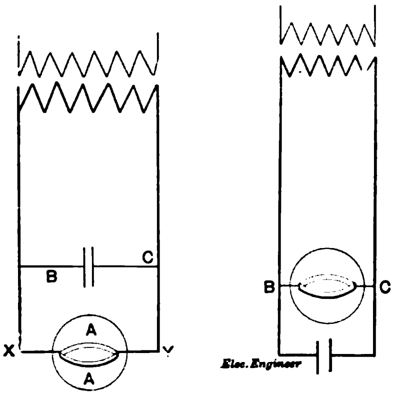


Fig. 8.

a portion of the magnetic circuit is through air, we have a volt-ampere or apparent watt expenditure in excess of the actual watt energy in circuit, due in large measure to the presence of the air gap in the magnetic circuit. We therefore have to apply a much greater electrical pressure or current, or both, to such a circuit than is represented by the waste and useful work. These phenomena necessarily incident to magnetic circuits magnetized by alternate currents may be stated thus: The fluxing of an alternate current magnet requires a volt-ampere or an apparent expenditure of energy greater than the actual watt value of the energy in circuit, and applying the statement to motors operated by alternate currents we may say, that in any motor (no matter what kind) operated by alternate currents the volt-amperes exceed the watts.

Fig. 3 represents a system of alternate current supply. A is the alternator, T T are the transformers, and M M the alternating-current motors of any kind. From the preceding statements and illustrations we know that the volt-amperes applied to the coils of M exceed the watts necessary to operate the motor, the ratio of watts to volt-amperes depending on the dimensions of the apparatus, on the skill shown in design, etc.

Now it is evident that the volts and amperes required by any motor must be supplied from the transformer to which the motor is connected; this transformer in turn calls upon the second transformer for an equivalent supply, which again demands a corresponding volt-ampere output from the alternator. The excess of volt-amperes over watts in circuit is thus shown to exist throughout the entire system and to increase the size and cost of each element of the system by its presence. But this is not all; it can be shown that the currents in circuit in any such system, whether one phase, two phase, or multiphase, lag, and that the regulation of each transformer and generator is seriously impaired thereby. The excessive "drop," or want of regulation, in the transformers can never be entirely compensated for by making them larger, while the false regulation of an alternator due to lagging currents in its armature can only be corrected by extreme excitation under very unfavorable conditions. Bearing these facts in mind, we have thought it necessary to devise some method by which the excess of the volt-amperes over the watts could be supplied from a local source, for as a portion of the volt-ampere value in circuit does not represent any actual work, it should be possible to produce this portion at, or confine it to, a local circuit at or about the motor, thus preventing its appearance in the transformers, lines and other portions of any system.



FIGS. 4 AND 5.

We have accomplished this result in a very perfect manner by introducing in the circuit capacity devices, employing either dry condensers or electrolytic condensers which we have termed polarizers. In the present article, we will confine ourselves to a description of the use of dry condensers arranged to furnish the excess of apparent energy above the real energy supplied to any motor.

Fig. 4 represents a condenser placed across the supply terminals of a motor; it can be shown that if the current flowing into and out of the condenser in amperes, is equal to the lagging component[1] of the current flowing into and out of the coil A A (the condenser being disconnected), that the two currents (the idle lagging current in the coil and the condenser current) will be impelled at all times by E. M. F.'s in opposite directions with respect to the mains; that when the idle current in A A flows from X to Y, the idle current in the condenser flows from Y to X, or, in short, that the idle current only flows in the circuit X, B, C, Y, and never flows in that part of the circuit connecting the condenser with the transformer; or if the apparatus be joined up as shown in Fig. 5, the idle current never flows back of the points C B. With this arrangement then (which is adapted for a constant potential supply system) the transformer mains and alternator only supply the actual energy current (plus a small higher frequency current superposed) and are consequently subject to the laws that govern such apparatus when supplying current to non-inductive circuits, thus greatly simplifying the problem of distribution. We believe the combination shown in Figs. 4 and 5 gives the key to the problem of power distribution, as it confines the lagging component or magnetization current to a local circuit, and reduces the cost of the transformers, mains and generators, which otherwise would be excessive for practical work.

WHICH IS THE ARMATURE?[2]

AN eminent Austrian firm of electrical engineers were very rightly offended when an English electrician said he could not tell which element of their dynamo was the armature and which the field. The multiple-current motor has had to put up with a series of insults of this nature. In the discussion on Mr. Snell's paper, read before the Institution of Electrical Engineers, on alternate current motors, the audience were reminded of the expedition against the "Snark," according to which classical epic the "bowsprit got mixed with the rudder sometimes." We ourselves have always been clear as to which is the armature and which the field, but our nomenclature has not been generally followed. We take it that in an alternating generator the element whose induction is constant is the field, and the part with the alternating current is the armature, and that the same relation holds good if the machine is run as a motor. According to the usual nomenclature, if two machines are coupled together as generator and motor, and if the load is altered so that we have motor and generator a sort of "general post" is necessary, so that what were at first field magnets become armatures, and what were armatures are suddenly changed to field magnets.

A METALLIC DIAPHRAGM IN ELECTROLYSIS.

THE term diaphragm is somewhat oddly, though still correctly, used when it is applied to a thin layer of mercury. Kellner has recently introduced a thin layer of mercury to separate the anode and cathode chambers in the electrolytic production of caustic soda. Sodium is deposited into the mercury on one side, and is dissolved out on the other, the result being that the caustic is produced free from chloride. Any hypochlorites in the anode chamber cannot attack the mercury, because the surface exposed to them is a cathode surface. The anode side of the mercury cannot be corroded, as it is in contact with caustic alkali, so the sodium is dissolved out instead. We believe, says *Industries*, that Mr. Vautin, of Commercial Road, London, E., has also been working on these lines.

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[1] The lagging component of a current is the true excess of volt-amperes over watts in circuit and is found by the equation

$$\text{Lag. comp.} = \frac{\sqrt{v a^2 - w^2}}{v}$$

$v a$ = volt. amp.
w = watts.
v = volts.

[2] *Industries.*

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY.—XVIII.

BY

A. E. Kennelly

If the flux distribution surrounding a magnet can be determined experimentally, with a field-explorer or otherwise, the attractive force at any point in the field can be computed. Fig. 37 represents the results of a particular case. Curve No. 1 connects successive observations indicated by circles, of the prime intensity along the axis of a large bar electromagnet (excited with constant current), as determined by a field searcher and ballistic galvanometer at each successive centimetre of distance. The intensity B_p descends from about 900 lines at one centimetre from the pole, to 70, at 16 cms. distance. The local inclination of this curve with the axis of abscissæ as determined by its tangents, gives a series of values for $\frac{dB}{dx}$ that are represented by curve II. The product at any distance from the pole of the two ordinates B and $\frac{dB}{dx}$ gives the locus followed by curve III to the left hand scale, and this represents the calculated resultant pull in dynes upon a sphere of iron 1 cm. in radius when μ is large. The pull at various distances along this path was measured in the cases of two iron spheres, one 0.665 cm., the other 1.904 cms. in diameter. The series of observed pulls in dynes divided by the cube of the radius of each sphere, in order to reduce the results to an equivalent sphere of unit radius, are shown by curves IV and V. The agreement between these and curve III is fairly good, and the deviation is perhaps no more than the size of the spheres, or their residual magnetism, might jointly account for in combination with errors of observation.

We have hitherto assumed the attracted particles

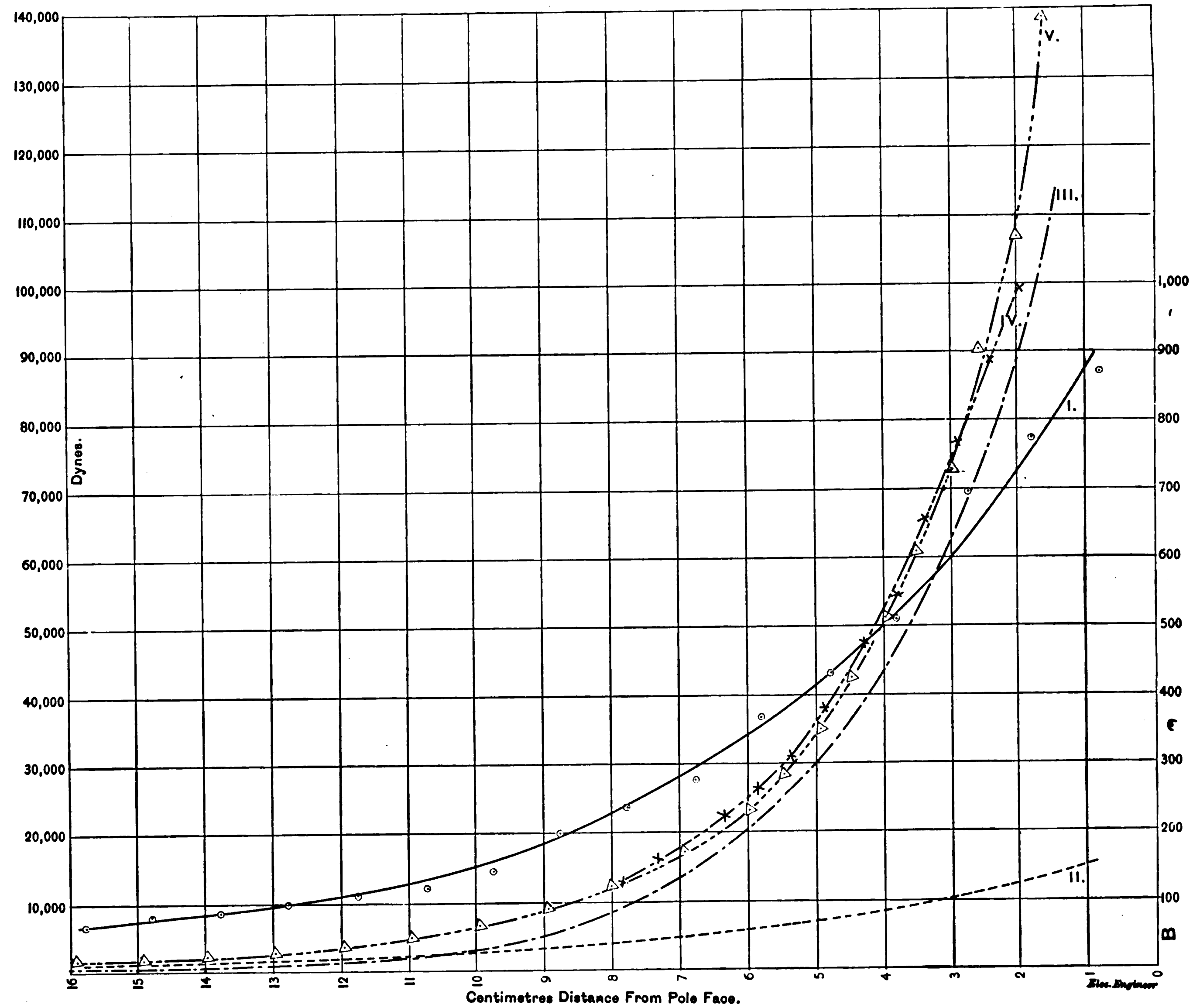

FIG. 37.—CURVES INDICATING THE RESULTANT DISPLACEMENT STRESSES ON IRON SPHERES PLACED IN MAGNETIC FLUX.

Ordinates of right hand scale, flux density (prime) along central line perpendicular to pole face; ordinates of left hand scale, dynes of resultant force; abscissæ, distance from pole face in centimetres. Curve I connects circles indicating observations of flux density by field exploring coil.—Curve II gives the rate of increase of curve I, or its gradient at each point dB/ds (dotted line).—Curve III (broken line) gives at each point the product of the ordinates in curves I and II or $B \times dB/ds$ to left hand scale in dynes on sphere 1 cm. in radius.—Curve IV connects crosses indicating observations of pull $/r^3$ on iron sphere 0.665 cm. in diameter.—Curve V connects triangles indicating observations of pull $/r^3$ on iron sphere 1.905 cm. in diameter.—Under theoretically assumed conditions, curves IV and V should coincide with III.

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are spheres, and of small diameter compared with the flux gradient $\frac{dB}{dx}$. If the particles are not spherical, they will tend to set lengthwise to the flux, and their local induced counterflux will exercise upon themselves less demagnetizing influence. The equivalent solenoids are therefore stronger, and the resultant stresses greater. In fact, of all forms that particles of given volume free to follow directive tendencies can assume, the spherical yields the least displacement stress. Also, as the particles are elongated, the influence of their permeability becomes more noticeable, and when the length is many diameters, the strength of the equivalent solenoid, and the resultant pull in a given flux increase directly with μ. Such rods, of soft iron, cast iron, steel, or nickel, might, under similar conditions, be expected to differ considerably in attractive force.

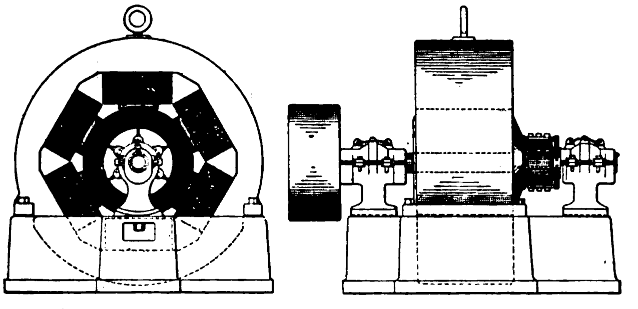
THE NEW WESTERN ELECTRIC MULTIPOLAR GENERATORS AND MOTORS.

In keeping with the progress of the times which tends strongly towards multipolar generators of large powers, the Western Electric Company have recently completed designs for a 150 h. p. dynamo, and the first of these is now being installed in their Chicago Works. This machine will generate current for a number of motors which will operate the machinery in the various shops, the multiplicity of belts and countershafting having long since been found to involve great expense in first cost and maintenance.

Our engravings, Figs. 1 and 2, show the machine in front and side elevation. It is of the multipolar Gramme ring type, compound wound for constant potential, or over-compounded if necessary. The brushes, of which there are six sets, are of carbon and are cross connected.

An essential feature of the machine is the low speed of rotation of the armature, being for this size but 255 revolutions per minute, or but from one-half to one-third of the ordinary speed of bipolar machines. This, of course, effects a great saving in power required to drive, owing to the reduction of frictional resistance. Also the wear and tear of journal bearings, commutator and brushes is correspondingly less. The commercial efficiency of the generator is 86 per cent.

The machine is of compact and symmetrical design. The bed plate is of deep cored section (24 inches), giving ample strength and stiffness. The dimensions on plan are 6 feet 10 inches by 7 feet 1 inch, and the height over all, 6 feet 7½ inches. The floor space required, including overhang of pulley, is 6 feet 10 inches by 8 feet 5 inches. The armature is shown in detail in Figs. 4 and 5. The shaft is of machinery steel, 6 inches in diameter, to which are bolted the three brass spiders A A A carrying the peripheral coils. Each of the six arms or spiders is provided with a clamp jaw, D, by which are held the longitudinal gibs C and keys B, both of brass, by means of which the necessary adjustment of the periphery is effected. The two through bolts shown in each jaw serve to clamp the gibs firmly in the adjusted position, while that shown passing through the lug in end of gib and tapped into small end of key, holds the latter in place.



Figs. 1 and 2.—New Western Electric Multipolar Machine.

The arrangement of winding of the coils is shown in section in Fig. 3, one half of one of the six segments being given in detail. There are in all 120 coils of six wires each, laid in the outer face in two courses of three, and in the inner face in three courses of two each. The method and material for providing the necessary insulation are noted, the several substances employed being cotton canvas and drilling, mica, vulcanized fiber and asbestos, each being selected according to its peculiar adaptability to the requirements of its location. Carbon brushes are employed which bear vertically on the commutator, and the pressure of which can be nicely regulated.

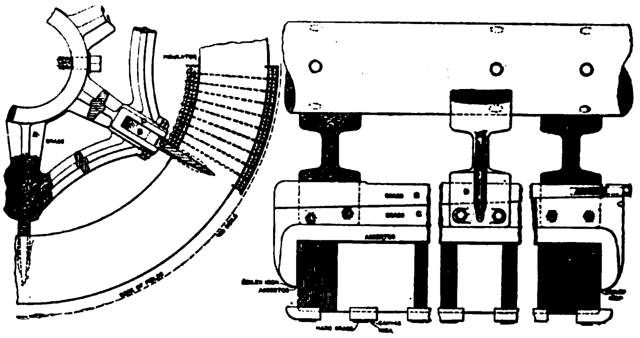


Fig. 3.

The self-adjusting ball journal bearings of the armature are provided with oil reservoirs and with the simple and efficient ring oil-feeding device, by which the lubrication is made automatic and perfectly reliable, there being a glass gauge to show the quantity of oil in the reservoir without the necessity for close inspection.

The total weight of the generator is 90 pounds per horse-power applied, or a trifle less than 105 pounds per developed horse-power. This will make the weight of the 150 h. p. machine about 15,700 pounds.

The new Western Electric motors are of the bipolar type, with drum armature and cast iron frame. They are designed for slow speed, the 10 h. p. machine running at 650 revs.

HIGH VACUUM TUBE PHENOMENA.

In a letter appearing in the London *Electrician*, Mr. E. C. Rimington writes as follows: I have several times tried placing a vacuum tube between two charged plates and suddenly removing it, hoping to obtain a luminous flash, but was always unsuccessful. Apparently the field at the edges fell off too gradually to allow a sufficiently rapid rate of change of induction through the tube when pulled out of the field by the hand. The other day, however, when showing the experiment of the rotating tube and excited ebonite rod to a friend, I found that when the tube was at rest on removing the rod suddenly there was a distinct flash in the tube. The same happened when the rod was suddenly approached or moved past the tube. Another form of this experiment is to take a straight tube (mine was about 5 inches long and ¾ inch in diameter) and rub it on a piece of flannel laid flat on the table, the whole of the tube being on the flannel; nothing much will happen in the way of luminosity so long as the tube is in contact with the flannel, as, of course, the electric induction passes from the outer surface of the glass straight to the flannel, which is practically in contact with it and does not go through the rarefied gas. On suddenly lifting the tube some of the induction will pass from the charged surface of the glass through the tube, and will cause a fairly brilliant flash in the tube.

Obtaining a luminous glow on rubbing an exhausted tube or bulb with a piece of silk or flannel is a very old electrical experiment, and has, I expect, been put to practical use before now for the purpose of obtaining (so-called) spirit lights by unscrupulous mediums at dark *séances*.

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Asso. Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
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New York Representative, 203 Broadway, } W. F. HANKS.
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SOWING THE WIND AND REAPING THE WHIRLWIND.

THE failure of the General Electric Company to get an injunction against the Columbia Company at St. Louis and the enormous depreciation of its shares on the New York Stock Exchange would seem to be the legitimate fruits of the seed planted by the promoters and organizers of the company. The St. Louis decision virtually overthrows the attempted monopoly of the incandescent electric lamp through the Edison patent, and the inexorable quantitative analysis of the Stock Exchange has brought the market price of General Electric stock down to somewhere near its real value. On Friday, May 5, the stock opened at 80, fell to 58 and recovered to 79¾. As we go to press it is quoted at 74–75. Having in view the first annual report of the company covering eight months to January 31, 1893, and the restatement or rearrangement of the balance sheet presented by our correspondent "Accountant" in our issue of April 26, it seems reasonable to regard General Electric stock as intrinsically worth a price per share somewhere between the limits of 80 and 58, covering the variations of Friday on the stock Exchange. General Electric, of course, shared in the decline of all the "industrial" stocks that so distinguished the last week of the stock market; but its depreciation is not to be wholly attributed to the distrust of "industrials" on the part of investors. In one respect the officers of the company have followed the example of other industrial corporations; that is to say, in putting forth incomplete, and possibly misleading reports, giving no statements of the amount of business done, no statement of gross profits, and no account of operating and administrative expenses. Stockholders and the investing public have to guess at these things for themselves. A considerable number of "industrial" stocks having got on the list of the Stock Exchange of New York, it is small wonder, in view of the paucity of information concerning their real value, that they have been the first to suffer under the financial strain of the past week. The formation of the General Electric Company a year ago resulted in gathering into one organization not only the elements of strength pertaining to some half dozen electric companies, but also their elements of weakness; the latter consisting mainly of stocks and bonds of local operating companies carried as assets in the yearly balance-sheets—together with an enormous accumulation of bills and accounts receivable. From the recent report of the General company it appears that the latter items held as assets amount to no less than $14,000,000, and that there is a contingent liability of $3,787,000, for bills receivable, endorsed and discounted. The stocks and bonds of local companies held were valued at $9,173,251. Patents, license contracts, etc., were put in at $8,159,264. The capital liabilities (stock and bonds) having been increased by the consolidation of last year over $20,000,000 (from $23,849,400 to $44,663,800) it is not strange that General Electric shares should tumble along with other industrials when the pinch comes, and when holders and investors have no adequate knowledge of the actual business and condition of the company.

Almost from the start, the leading electric companies —so many of which have been absorbed by the General company—have chosen to go into the business of promoters, and virtually the business of bankers; for the purpose of increasing their sales, they have received and carried the stocks and bonds of local companies in payment for their products, instead of conducting their business as manufacturers simply. They have thus undoubtedly forced their business beyond its normal growth and have accumulated a vast mass of doubtful securities in the treasury of the General company. There is no magic in electricity—and apparently not much in patents—to protect corporations from the consequences of undue inflation of capital or of reckless greed.

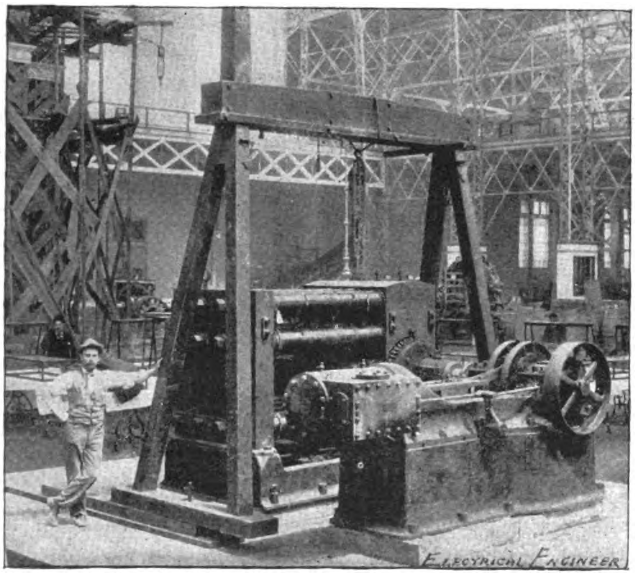
STANDARDS IN MEDICAL ELECTRICITY.

THE curative value of electricity though recognized at an early date, has but comparatively recently been accorded that attention by the medical profession which it deserves. This long delay may be ascribed to the employment of this valuable medical adjunct by quacks and charlatans with whom reputable practitioners did not care to enter into competition. Luckily this is now no longer the case, and electricity has entered upon its legitimate sphere of usefulness in medicine. Evidence of this is to be found in its increasing employment by physicians, but above all by their adoption of instruments for determining exactly the conditions of its application. This was a great step in advance, but that there is still much to be done towards obtaining the full benefit from this agent is manifest from the proposed action of the American Therapeutic Association whose circular we publish on another page. The various committees appointed to standardize electro-medical apparatus have before them a most important work, which, if properly carried out, will be of immense benefit not only to the medical profession for whom it is primarily intended, but for the entire electrical profession as well. With such men as Dr. W. J. Morton, Dr. Robert Newman, Dr. Frederick Peterson, Dr. A. H. Goelet and other successful practitioners, and with the able assistance of such experts as Mr. A. E. Kennelly, the outlook for intelligent and conscientious work seems most hopeful. Although medicine is not classed among the exact sciences, it is hardly too much to venture the assertion that electrotherapeutics may become the most "exact" department of medical science. We sincerely hope that all those who can will aid the committees by suggestions and otherwise.

WORLD'S FAIR DEPARTMENT.

"JUMBO."

Among the long list of the General Electric Company's exhibits at the Fair perhaps the most interesting from an historical standpoint is the first direct connected engine and dynamo which was considered such a marvel of electrical and mechanical engineering only 12 years ago. To those so very old in the profession as to have been interested in electrical matters at the time when this machine was built this account will perhaps not be of especial value, but there are thousands who have sprung into active life within the last eight or ten years, or less, to whom a comparison of present engineering methods with those in vogue only a little more than a decade ago may be of interest. The odd thing about it all is that what is now considered essential to the best central station practice, namely, direct connection, was long ago established and has taken all this time to become recognized.



Installing "Jumbo" at the World's Fair.

In the little exhibit of electrical apparatus at the Centennial the only dynamos shown were arc machines of small capacity, and the first so-called large incandescent generators built about 1881 did not exceed from five to ten horse-power. Mr. Edison, it will be remembered, never cared to potter with isolated lighting, but started from the first to introduce electric illumination on a commercial basis. The first central station in the world using the underground system, that of the Edison Electric Illuminating Company of New York on Pearl street, was brought to maturity by him and was finally started on September 2, 1882, although in course of construction for a long time previous to that date. To generate current on a large scale it was evident to him that units of a more comprehensive character and of greater economy might be employed. A generator coupled directly to the engine would, of course, be more efficient as belt friction would be eliminated, and besides it would take up less space and attendance. It was at this point that the first annoyance was encountered. The engine builders refused to guarantee to produce an engine to run at such an extraordinarily high speed as would be necessary in the case of direct connection. The Porter-Allen people were at length induced to try it, but the engine failed in the vital essential of regulation. This defect Mr. Edison took it upon himself to remedy, and the records of the Patent Office show that he applied for and secured a patent for the purpose, which was subsequently put into use, in principle, on high speed engines. This is another instance of the indomitable will and perseverance of this remarkable man. If balked in the attainment of his object by an obstacle wholly outside of his chosen field of work, he has never been by any means averse to digressing long enough to remove the difficulty, even though it may become necessary, in so doing, to teach new methods to those whose lives had been spent in the study and practice of *their* business.

The regulator in question not being readily adaptable to the Porter-Allen engine designed for a speed of more than 300 revolutions, the Armington & Sims Engine Co. were given an order. This engine they were reluctant to guarantee, however, as to the speed required. Mr. Edison assumed for its modest manufacturers the risk for its performance. He then began experimenting with it coupled directly to the generator, and on some tests reached a speed of over 600 revolutions per minute. This unit subsequently made in one instance runs of two weeks at a time, day and night, without a moment's pause.

Though the success of this first direct-coupled machine, so early demonstrated a decided economy of both power and space for central station work, it took several years before the practice became general, and units have only comparatively recently begun to assume the grand proportions now seen in many stations throughout the world, and more especially at the Fair.

"Jumbo" as it is called from what was considered its immense size when it made its début, is a loan from the Edison Electric Illuminating Co., of New York, from whose Pearl street station it was taken to be shipped to the Exposition. It was taken out of actual service to be sent away, and will be re-erected on its old foundation next fall where it will continue work until displaced by more modern practice. Eight or ten machines of this type are now doing service in Milan. The Pearl street station had eight, six of which were originally installed. The enlargement of the company's stations with the necessity for correspondingly larger units, displaced all but this one which continued in active operation. During the fire that destroyed the station on New Year's day, 1890, "Jumbo" went on generating current in three feet of water while the firemen were playing the hose upon it from the roof! For the last eleven years it has averaged five hours service a day and, as stated before, is still part of the regular working equipment of the station. As one enthusiastic admirer said, its armature has run far enough to take it five times around the globe. The weight of the armature is about six tons; that of the whole generator ten tons, while the total weight of the engine and generator combined is 17 tons. The rated capacity of this machine is 600 amperes, although on a forced load it has a record of 1395, while the engine driving it is nominally of 140 h. p., but has, of course, exceeded this to a corresponding extent, having driven the dynamo while furnishing the current on which the record was made. It would be running now in the Electricity Building but for the fact that no steam is to be had. Mr. W. H. Mackay, constructing engineer, was sent to Chicago by Mr. H. J. Smith, superintendent of the station, to erect "Jumbo" at the Fair.

Not only in this country has this first of its race excited the interest of electricians. In 1881 it was sent across the ocean and exhibited at the Paris Electrical Exposition, where it was shown in operation prior to the completion of the Pearl street station in New York. In Paris its enormous size, according to the existing standards, created a veritable sensation, and even the savants, as the published accounts tell, were astonished at this bold departure in electrical engineering. It is said of Count DuMoncel that he was an almost daily visitor and would remain for hours wrapped in admiration, or walking about the new wonder examining it on all sides and stroking the field coils tenderly as he would the mane of a favorite horse.

"Jumbo" has a good position at the Fair, just at the base of the brilliant Tower of Light in the centre of the building and loses nothing of its dignity by the proximity of all the examples of modern practice in dynamo design.

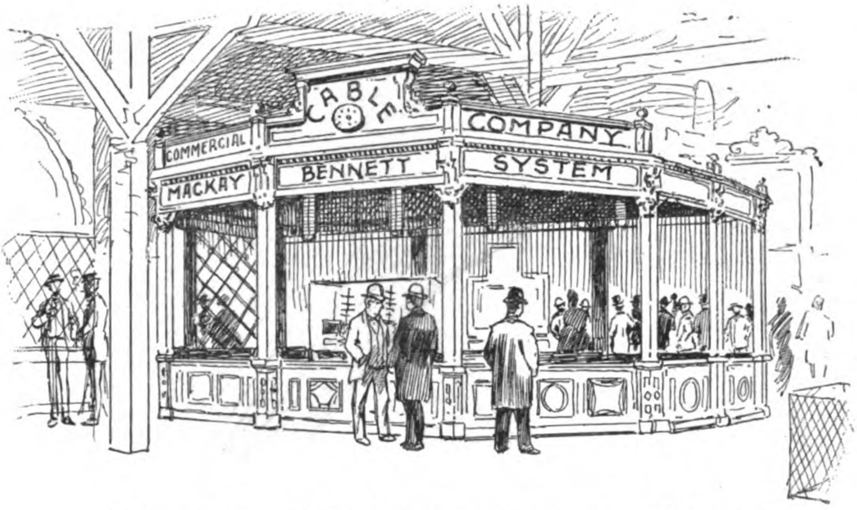
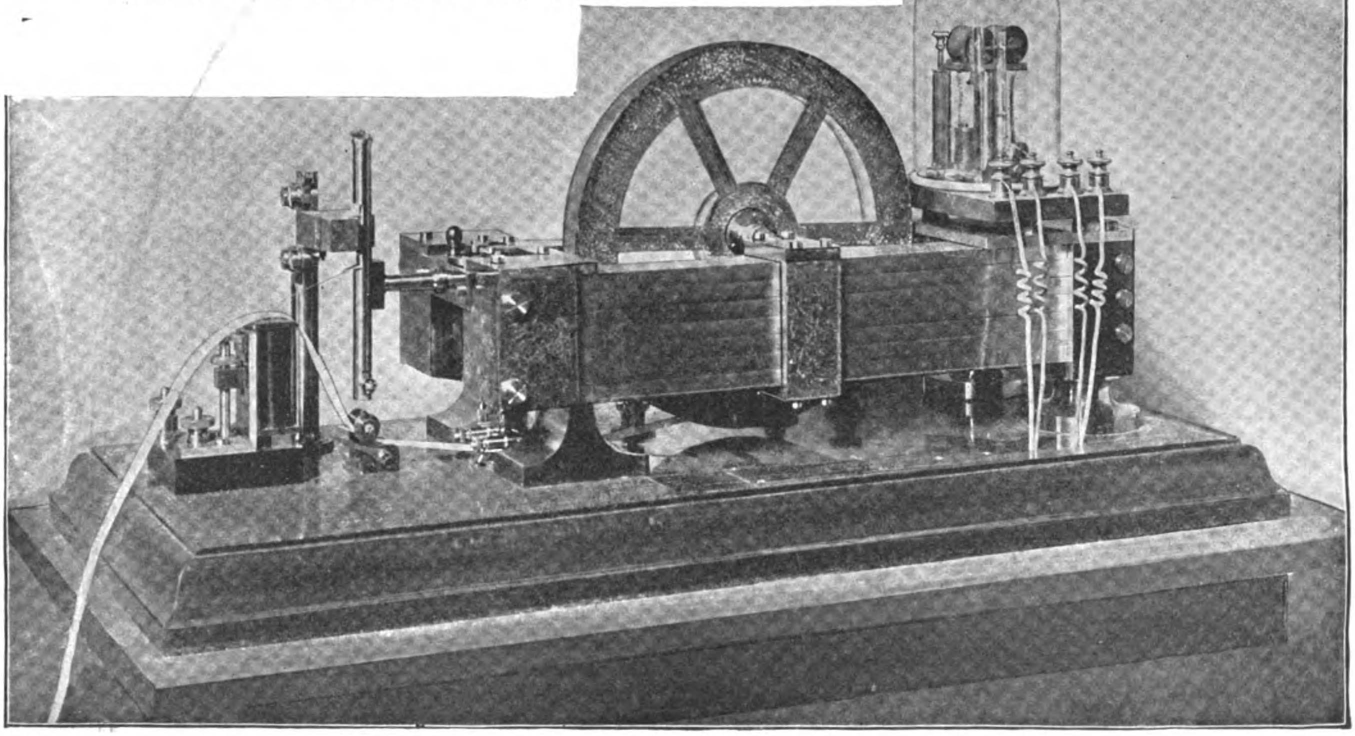


Exhibit of the Commercial Cable Co. in Electricity Building, World's Fair



Cuttriss Siphon Recorder in the Exhibit of the Commercial Cable Co.

DISPLAY OF THE COMMERCIAL CABLE COMPANY.

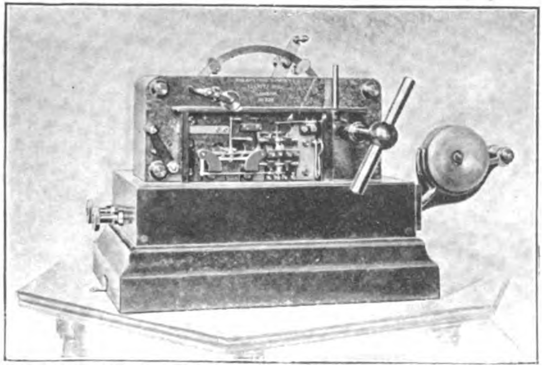
About the centre of the west gallery of the Electricity Building stands the booth of the Mackay-Bennett Commercial Cable Company, in which is shown a working exhibit of the method of operating the Atlantic cable duplex. The artificial cable made specially for this exhibit by Dr. Alex. Muirhead, of London, is in all its electrical particulars an exact duplicate of one of those in actual operation, with the duplex arrangement at either end, and gives an idea of the time required for a signal to cross the ocean. The instruments are all of the most approved modern type showing the latest development in automatic submarine telegraphy, and were especially made for this exhibit. One of these is an automatic transmitter, modified from the Wheatstone to suit cable work, by Mr. T. J. Wilmot, one of the company's superintendents at Waterville, Ireland, and is an extremely interesting piece of mechanism. Mr. Wilmot was the first to successfully introduce automatic working on long submarine cables.

The second transmitter is the latest invention of Mr. Charles Cuttriss, the company's electrician in New York. This instrument, although it has been in practical operation only during the last five months, has already greatly simplified the process of automatic transmission. There are certain unique points possessed by this machine, however, that I may briefly touch upon here.

Hitherto the great drawback in automatic transmission has been the extreme nicety of adjustment required in the timing of the contacts and their liability to oxidize from very heavy discharges when the cable was grounded at the sending station. In Mr. Cuttriss' arrangement, these drawbacks have been obviated by the use of an intermittently moving sprocket wheel working in conjunction with a cam, the two being so timed that the delicate contact points are never opened or closed while any current flows between them. Another important point is that the perforator, instead of actually removing a portion of the paper to determine the contacts, merely punctures the slip. This does away with the delay and labor of constantly sharpening the very complicated punch ordinarily used. The motive power is derived from an electric motor requiring only 10 volts, ½-amp., of current. The main shaft which carries the armature also carries the worm which moves the sprocket wheel and cam, and as there is only one more revolving shaft in the instrument it will be seen that no expert will be required to keep it in adjustment.

It is, of course, absolutely necessary for accurate transmission that the paper slips should have a series of perforations, spaced with the utmost accuracy, by which they are moved forward under the contact points. This row of holes is along the centre and is previously made by a special machine, whole rolls of paper being perforated and laid away ready for use. This little machine, though very simple in construction, required more labor before it was perfected to the satisfaction of the inventor than any other part of the apparatus, and in its accepted form does its work with mathematical accuracy at 2,500 perforations per minute.

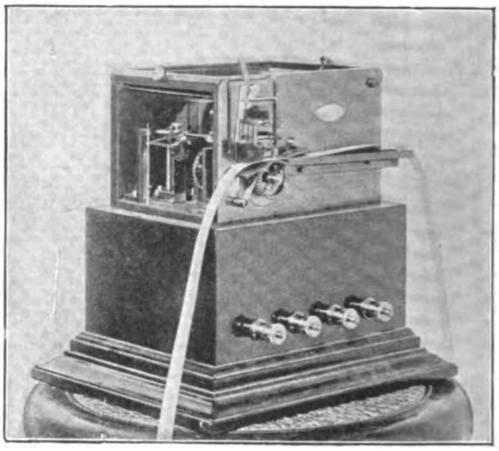
The two recorders shown in this exhibit were also designed by Mr. Cuttriss. These embrace many new features, and have done the most rapid work on record for instruments of their class, a speed of 300 letters per minute being constantly maintained in actual practice over one of the company's cables. This extraordinary rapidity is in part owing to the fine workmanship of the instruments themselves and in part to the manner in which the moving coil is controlled. Instead of using fibres and weights or springs, as has hitherto been the practice, magnetic attraction has been substituted and operates as follows : the coil is pivoted with the greatest delicacy on jeweled bearings, and attached to its upper end are two pieces of iron wire $\frac{1}{16}$ inch in both diameter and length. Projecting from the pole-pieces of the large permanent magnet are two other pieces of iron not unlike those of an ordinary polarized relay, and so situated that, while their attraction for the small pieces on the coil tends to put the latter under a strain in the magnetic field, it also tends to take the weight of the coil from the bottom pivot, thus reducing the friction to a minimum. The siphon is vibrated by magnetism in the manner already fully described in these columns.



Wilmot Automatic Transmitter.

The motors for drawing the paper slip upon which the records are made are very compact and are so constructed that they will work equally well on a circuit of six ordinary gravity cells or an Edison electric light circuit. They are provided with governors which regulate their speed much more perfectly than did the discarded clockwork arrangement. For transcribing the messages, the typewriter has been adopted because of the large number of code and cipher messages used in cable work, where the mistake of a single letter in the reading of a dispatch might altogether destroy or utterly change its original meaning.

In the centre of the pavilion occupied by the exhibit stands a large and beautifully finished model of the company's repairing ship, "Mackay-Bennett." All the machinery on the decks is in exact fac-simile of the actual apparatus. The picking-up and paying-out gear are shown with the hawser and grapnel over the bows, and caught up by the latter is a piece of cable in the same position in which it would be if just drawn fron the water ready to be cut and tested from the ship ; while over the stern hangs a length of cable in the act of being paid out to lay a new section.



Cuttriss Automatic Transmitter.

The remainder of the display shows samples of various types of cable and also many "faults" that have been recovered from the depths, as well as pieces of cable of the heaviest types cut almost in two and battered out of resemblance to anything in particular, by ice floes. Close beside these is shown the latest form of cable especially designed to resist this action, the core covered with short sections of heavy steel tube so articulated as to admit of a reasonably short bend.

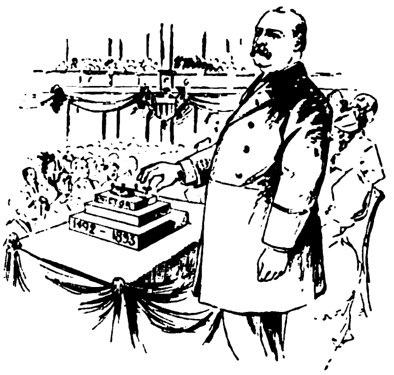
This practically closes the exhibit proper. The booth containing it is in itself a beautiful piece of woodwork, artistically designed and carefully finished, and is lighted by three low-tension arc lamps of graceful appearance made by the Incandescent Arc Light Company of New York. Mr. Cuttriss' ingenuity has been put to a severe test by the action of the Exposition authorities in changing about the spaces originally assigned, and in compelling his booth to stand in a position quite different from that for which it was designed. He has surmounted the difficulty, however, and it is safe to say that few, if any, of the exhibitors represented will show to the public a more compact and judiciously selected collection of interesting apparatus than the Commercial Cable Company.

The booth itself is a very handsome piece of cabinet work. It was erected by the Pyrogravure Wood Co., of New York.

PROGRAMME OF THE ELECTRICAL CONGRESS AT CHICAGO.

The Committee on Programme and Papers of the Electrical Congress to be held in Chicago next August, met at Washington, D. C., on April 21st. The proceedings of the Congress were thoroughly discussed, and a programme adopted which will be published within a short while. Among those present were Prof. T. C. Mendenhall, chairman, Profs. Rowland, Nichols, Carhart, Crocker and Mr. Kennelly.

ELECTRICITY AT THE OPENING OF THE FAIR.

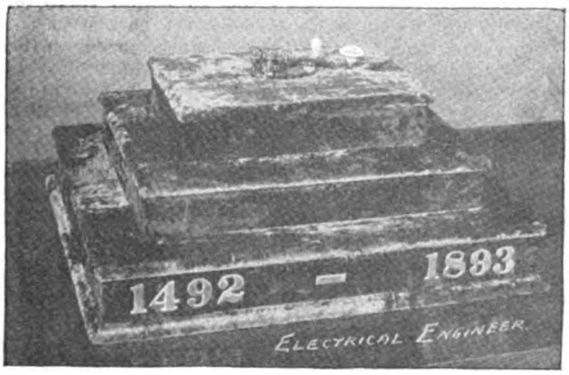


Starting the World's Fair Machinery.

WITH the impressive opening ceremonies of the World's Columbian Exposition on the first day of May, 1893, our readers are already familiar through the daily press. The immense crowds, the waving banners, the speeches, the uniforms of the visiting officers and the dignity of the President's bearing and democratic black coat have all been treated ad libitum, if not slightly ad nauseam. At the close of the exercises, however, when the orators had orated to their heart's content and the populace had plastered itself in the mud and hurrahed itself hoarse, Grover Cleveland, President of the United States, in the midst of a mighty Central Asian silence, touched with his finger the golden telegraph key that completed the starting circuit with the great engine in Machinery Hall, and the enormous pump supplying the electric fountains with water, and the World's Fair had become "a thing of the present." The next day the workmen all resumed their labors and a few things will be in running order by the beginning of next month if all goes well—perhaps and possibly.

THE ELECTRICAL ENGINEER was so fortunate as to secure a photograph of the key used to open the Exposition officially, and presents an engraving of it on this page. This is a Victor key made by The E. S. Greeley & Co., of New York, and differs from the standard Victor only in regard to material and finish. Instead, however, of being made of brass with rubber mountings as used, this key is of solid gold, with fittings of ivory, and was mounted for the occasion on a plush stand consisting of three successive steps, the tops of blue and the sides of yellow to represent the national colors of America and Spain; while at the opposite ends of the lowest step are the dates, 1492–1893. The stand was also made by the same company that manufactured the switch, and the whole will form perhaps the most interesting feature of their large and well-selected exhibit.

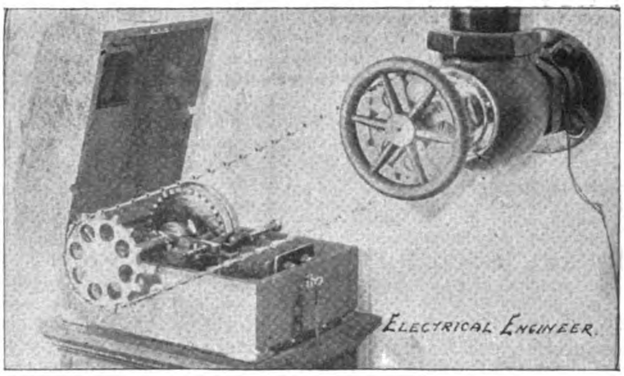
The devices for starting the engine and pump were connected in series with the key, and twelve cells of Exeter dry battery supplied the current. The president in closing the circuit, first pressed the key lever and then closed the circuit breaker in order to keep the circuit closed and allow the starting mechanism time to act. The installation was made by Mr. L. Ethridge, superintendent of the Worlds Fair fire alarm service, and Mr. L. J. Auerbacher, electrician for The E. S. Greeley & Co., and in entire charge of their exhibit, to whom is due the arrangement of the starting circuits and the general supervision of the whole matter. The pressure of the crowd to touch the key immediately after the ceremonies, was so great that Mr. Auerbacher cut the wires and with difficulty forced his way out. He was corralled by the statesmen and members of the Cabinet, however, who all fondled the instrument, and one of whom offered $5,000 for it on the spot. But he didn't get it, and it is now carefully locked up in the vaults of the Administration Building.



THE WORLD'S FAIR VICTOR KEY.

The conductors were run under the platform and thence through the subway to the Allis-Corliss engine in Machinery Hall. Thence another wire extended to the pump house at the east end of the hall where the great Worthington pump is situated. The electric fountains were operated by separate circuits from the northeast tower of Machinery Hall and were started by a signal in multiple with the main circuit. There was not the slightest hitch in the proceedings and everything worked to the perfect satisfaction of those in charge and the intense delight of the multitude.

The device used for opening the throttle of the great Allis-Corliss engine in Machinery Hall, is the invention of Mr. Frederick D. Taylor, of Hartford, Conn., and is manufactured by the Electro-Automatic Appliance Company, of the same place, and is very clearly shown in the accompanying engraving. A shaft mounted on bearings attached to the bed plate has a sprocket wheel secured to its outer end, while near the opposite end is one member of a clutch consisting of a spring barrel provided with a ratchet on one face. The spring is helical and one end is fixed upon the shaft on which the barrel turns. A part of this shaft it threaded and supports a nut having a sliding movement but held against rotation by a notched flange engaging a guide secured to the frame and provided with a shoulder to determine the distance over which the nut may travel. A shipping lever is pivoted at one side of the shaft and extends across it as shown.



ELECTRIC STARTING APPARATUS, WORLD'S FAIR.

The other member of the clutch consists of a spring pawl whose end engages with the ratchet and holds the spring barrel in any desired position, and the shipping lever, projecting across this pawl engages a guide slot in a tumbler pivoted to a fixed part of the frame and having an arm adapted to engage a catch on the outer side of the armature of an electromagnet. The sprocket wheel on the end of the shaft first mentioned is connected by means of a drive chain with a similar wheel at the throttle valve of the engine. The spring in the clutch was wound up by the simple process of closing this valve and was held under tension until the closing of the circuit at the other end of the line by the pressure of the President's finger upon the golden Victor key.

The trip device operates by means of a slide, bearing at its inner end, next the nut, a block which yields to allow the nut to move freely toward the shipping lever, but is so arranged that the nut will strike it when moving in the opposite direction and disengages the slide.

The operation is extremely simple. When the circuit is closed, the armature is drawn toward its magnet, thus releasing the outer end of the tumbler. The shipping lever then being free to move is thrown over by its spring and withdraws the pawl from the ratchet on the barrel, leaving the latter free to revolve under the action of the powerful coiled spring within; and this motion is communicated by means of the shaft, sprocket wheels and drive chain, to the throttle valve of the engine.

An arrangement is also provided for mechanically releasing the spring barrel if desired by simply pressing upon the outer end of a rod whose inner end engages the pawl and moves it away from the ratchet. The whole device is enclosed in a handsome hardwood case.

The Worthington pump was started by a very clever little electromagnetic arrangement made by Messrs. Nash and Eddy, of Cleveland, Ohio. This machine has only just been perfected and no drawing of its parts have yet been made. A brief description will, however, suffice to show its modus operandi. The main steam supply pipe is closed by a transverse piston valve operated by steam which is admitted from a small shunt pipe. This shunt pipe is also closed by a much smaller piston valve controlled by an electromagnet, so that when the circuit is closed the smaller piston valve admits steam to the end of the larger valve cylinder, actuating its piston and opening the way to the pump itself.

CLOSED ON SUNDAY.

THE WORLD'S FAIR, with all its treasures of art and science, and beauties of landscape gardening, was closed up as tight as a drum on Sunday. But the saloons of the city of Chicago, and around the Fair were running "wide open" and the Buffalo Bill Wild West Show had one of its greatest days.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS AT THE FAIR.

At the council meeting of the Institute held March 21st, 1893, it decided to establish official headquarters for the Institute in the Electricity Building at the World's Columbian Exhibition. These headquarters, which will be in charge of the secretary, Mr. R. W. Pope, will be equipped with long distance telephone, telegraph and messenger service, police and fire protection, and electric light, and facilities will be given, not only to the members of the Institute but to visiting electricians from abroad, to write their letters and have their mail addressed there, leave their packages, meet their friends, and read the files of scientific papers, and a handsome electrical library will be placed at their disposition. In addition to this the two rooms which have been set aside by the authorities at Chicago for the use of the Institute are to be equipped with interesting historical relics which will make the headquarters one of the most interesting spots in the Electricity Building.

The Institute has already laid out its plan for the due execution of this programme, and is raising a special fund to meet the expenses. The Committee on Ways and Means. for the purpose, is W. J. Hammer, chairman, F. R. Upton and W. A. Kreidler.

QUEEN & CO.'S EXHIBIT IN ELECTRICITY BUILDING.

Under the title "Some Features of the World's Columbian Exposition," Queen & Co., of Philadelphia, have issued a very interesting pamphlet relative to the World's Fair in general, and their exhibits in particular. They have made very elaborate preparations, and will have a corps of experts on the ground under the direction of Mr. C. W. Pike, S. B. The electrical exhibit is being placed in Electricity Building as already noted in The Electrical Engineer.

The electrical exhibit will prove exceedingly interesting to all engaged in electrical science. In it will be found a complete series of Queen regular standard electrical test instruments, together with new high-grade apparatus of great importance recently produced in the Queen experimental laboratory at Ardmore.

Among them the following should be carefully examined: The ballistic galvanometer, new horizontal magnet D'Arsonval, Ryan electrometer, Moler swinging-arm galvanometer, a new pattern of Thomson astatic galvanometer of exceeding sensitiveness, two different designs of the Carey-Foster commutator and a new design of the cylinder bridge, the new form of a standard ohm, and the apparatus for measurement of temperature coefficients and conductivity. The test instruments for student use, include a new magnetometer, earth inductor, Rumford photometer with dispersion lens, a new design for condensers, universal tangent galvanometer, D'Arsonval galvanometer (wall pattern) and quadrant electrometer.

On the switchboard in Queen & Co.'s Electrical Pavilion are placed examples of their magnetic vane ammeters and voltmeters of various styles and ranges, Cardew voltmeters and new hot wire instruments, both ammeters and voltmeters.

Besides the above switchboard instruments is a new portable testing set which is remarkably compact and efficient. Of equal merit is a portable cable testing set with which measurements upon the insulation resistance and capacity of cables may be made in the street.

A comprehensive line of Lord Kelvin's standard ampere balances, etc., is shown, which in itself will make a magnificent exhibit. The demonstration apparatus in electricity and magnetism, includes lecture dynamos and accessory apparatus, Toepler-Holtz and Wimshurst machines, induction coils and Hertz mirrors with resonators. In the dark room they show in operation their standard electric light photometer with Lummer-Brodhun sight box, a new Paragon electric projection lantern, working with alternating current and a splendid collection of Crookes, Geissler and spectrum tubes.

In the Electrical Pavilion will be files of the electrical journals and an electrical reference library. Several other fine exhibits of scientific apparatus interesting to the electrical engineer are made in the Liberal Arts Building.

Queen & Co. will be glad to mail a copy of the above pamphlet to intending visitors who will find it of much assistance, containing as it does general information regarding Chicago and the Fair, and exact particulars as to the location and character of each of their exhibits. Application should be made at once as the supply is limited.

The Taylor Electric Truck Company, of Troy, N. Y., will have on exhibition at the World's Fair a number of their trucks for motor cars; among them, one for the General Electric Company to exhibit the latter's motor upon. This truck is to be equipped with a Genet air brake.

HISTORICAL DYNAMOS IN THE ANSONIA ELECTRIC COMPANY'S EXHIBIT.

To illustrate the evolution of the dynamo, the Ansonia Electric Company will exhibit in its pavilion the four first dynamos of their respective types constructed or operated in the United States.

The old Wallace-Farmer machine, which was continuously in operation at the Centennial in 1876; the "Telemachon," which is well known to students of the history of electricity in the United States; the Gramme dynamo, built by Prof. Anthony of Cornell University in 1874, and exhibited in Philadelphia in 1876, and which is now running and doing good work as a motor in the Department of Physics at Cornell, some of the original sawed carbons first used in electric lighting; and other machines and appurtenances will be exhibited. They will be a very pleasant study for the electrical engineer. The Wallace-Farmer dynamos were recently illustrated and described by Mr. W. J. Hammer in The Electrical Engineer.

"GRIMSHAW" AT THE WORLD'S FAIR.

It will be remembered that the New York Insulated Wire Co., of 15 Cortlandt street, New York, received the contract for the wiring at the World's Fair, for the installation of nearly 100,000 incandescent lamps. The company are naturally very proud of the preference thus shown for their "Grimshaw" white core wire, tape, and "Vulca" ducts, and to commemorate the occasion have just issued a very tasteful and complete World's Fair edition of their well-known catalogue and price list. As a frontispiece there is a beautiful half tone view of the Fair, showing the whole of Jackson Park, and then follow a large variety of tables, cuts, data, etc. The closing list of buildings wired with "Grimshaw" is a magnificent tribute to the merits of the insulation which bears that name.

One new table, of considerable interest and value, is that contributed by Mr. John A. Seeley, electrical engineer and expert, giving dimensions and resistances of copper wire in sizes larger than No. 0000 B. & S.

MISCELLANEOUS.

THE BLACKENING OF LAMP BULBS.[1]

Few subjects have given rise to more speculation than the blackening of the bulbs of incandescent lamps. At one time it was said to be due to platinum thrown off from the leading-in wires. Then it was due to something mysteriously called "air-washing." Some people are fond of working mystery into explanations of anything where electricity or high vacua are concerned, so that when they exist together there is a double tendency towards the mysterious. Recently mercury vapor has been said to be the cause of the blackening, but this theory seems to have been developed more especially by American inventors of mechanical pumps, which do not use mercury. There is still another theory, due, we believe, to Sawyer, according to which there is some oxygen in the bulb which combines with the carbon at the very high temperature produced, then deposits the carbon on the glass and goes off to the filament again for more, and so on. It does not matter at all with this theory that there is no known oxide of carbon which decomposes automatically at a low temperature. In a vacuum and in an electric lamp the laws of chemistry ought, it would seem, to be quite different from the humdrum laws of nature under pressure with no electric current about. It is possible that hot carbon slowly volatilizes considerably below its melting point, just as camphor does. This theory would be too simple, however. It would be safer to assume that the difference of potential between the legs of the filament causes currents across the air space—hot rarefied gases being good conductors—and that these cause the carbon to leave the filaments and to be deposited on the glass. The whole subject requires to be investigated carefully, and would probably well repay any time and trouble expended upon its elucidation.

THE HELIOGRAPH IN NEW YORK.

Some interesting experiments were made a short time ago to place the cities of New York and Brooklyn in communication with each other by means of the heliograph. Captain E. B. Ives, signal officer of the First Brigade of the National Guard of this State, and Corporals Butler and Fones and Private Samson of the Signal Corps, stationed themselves upon the top of the Western Union Building, in New York, while a squad from the Second Brigade occupied the top of the Franklin Trust Building in Brooklyn. These experiments were so satisfactory that Captain Ives will apply for permission to erect a permanent station on the Western Union Building, while other stations will be arranged for in Brooklyn, Eldorado, Staten Island and on the Orange Mountains.

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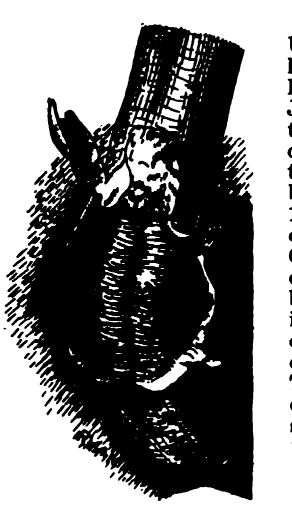
[1] *Industries.*

A CABLE RUPTURE.[1]

BY HARRIS J. RYAN.



Breakdown of a High Voltage Cable.

A RUPTURE occurred on one of the University high pressure incandescent lighting cables at the entrance to the library building about the first of last June. A fair idea of the appearance of the cable at the point of rupture is obtained from the accompanying illustration. It occurred about 9 inches back of the terminal cup of the No. 10 B. & S. G. duplex branch from one of the main duplex No. 6 B. & S. G. cables. The insulation for each conductor of the main, as well as the branch, is laid onto a thickness of $\frac{6}{32}$ inch. It consists of a wrapping of cotton yarn saturated with ozite, and over all is a stout covering of lead. Three or four days before the occurence of the rupture the results of tests showed the insulation resistance between the conductors for this cable to be 40,000 megohms. The length of the main cable is 1,950 feet, while that of the branch is about 300 feet. The total capacity between the conductors is .066 microfarads. At the time that this rupture occurred the cable supplied current to seventeen 40-light transformers. The insulation is designed for a working maximum pressure of 2,800 volts. The cable had been used for 1,000 volt alternating currents during the university year that preceded the date of the accident. From the appearance of the rupture, the conditions under which it occurred, and the good state of insulation known to have existed in the cable, it is evident that the rupture was caused by the presence for a mere instant of a very high electrical pressure. This pressure was great enough to produce a disruptive discharge from one conductor to the other through the intervening space, a distance of ⅜ inch, at a point where the insulation had been separated slightly by the sudden bend that was given the cable just below the terminal cup.

The rupture was not discovered until the middle of August. Current had not been supplied through the cable since commencement, June 20. About June 10 the cable was thoroughly inspected, and the insulation resistance found to be in the neighborhood of 40,000 megohms. In this way the date of the rupture is fixed somewhere between June 10 and June 20. Immediately after the discovery of the rupture in August, the insulation of the cable was found to have fallen to 20,000 megohms,, a drop fully accounted for by the absorption of moisture from the atmosphere at the point of exposure. The high insulation both before and after the rupture, together with the fact that the rupture took place at a point where the cable in normal condition is most vulnerable,—where the insulation was parted by a sharp curvature in the cable,—all give plenty of evidence that arcing of the current from one conductor to the other was not produced by a fault in the cable insulation. The ruptured cable terminated in the transformer vault of the General Library building. In this room is the switchboard for controling the lighting of the building.

After the rupture was discovered, the janitor, whose duty it is to control the lighting, upon examination stated that one evening while closing the switches on the secondary circuits in this room an explosion, accompanied by a loud report, occurred at a point on the north wall where the cables enter, and from there a tongue-like flame appeared for an instant only. It seems highly probable then, that the act of switching lamps onto the secondaries of the transformers may have given rise for the moment of a component E. M. F. in the primary circuit of the proper periodicity and value for the setting up of an extra current through the dynamo and cable. The condenser property of the cable and the self-induction of the alternator armature form an electric circuit through which a considerable current may be established at the right periodicity with but a small actuating E. M. F. Currents thus established produce generally at the terminals of the condenser and the self-induction part of the circuit enormous E. M. F.'s the sum of which at any instant is zero, but for which the strain on the insulation of the circuit is just as great as for ordinary E. M. F.'s of the same value. It is probable that in some such way as this the electric discharge producing the rupture occurred.

It is hoped that persons who have come across occurrences of this sort will publish the facts as they know them in order that the data thus accumulated may be used for determining whether or not it pays to put on the "arresters" for the avoidance of results that follow disruptive discharges in the working of underground cables.

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[1] Abstract from the *Sibley Journal of Engineering*, April, 1893.

STANDARDIZING ELECTRO-THERAPEUTIC APPARATUS.

WE are in receipt of a circular issued by the secretary of the American Electro-Therapeutic Association, Dr. Margaret A. Cleaves, 68 Madison avenue, New York, inviting members of the medical profession, electrical experts and manufacturers of electro-medical apparatus to communicate with the committees of the society appointed for that purpose. Manufacturers are requested to submit their instruments for examination and test, stating their claims and merits, and all the above-mentioned are asked to co-operate in making suggestions in relating their experience and preference for instruments with reasons and data.

We give below the subjects upon which committees have been appointed, together with the points to be considered :

Standard Coils :—I. Portability. II. Practical mechanism of machines as adapted to physicians' use. III. Range and rate of vibration. IV. Electromotive force and its range in relation to resistances to be overcome. V. The resistance of the coil producing these electromotive forces. VI. The battery-power required for individual coils. VII. Shape of the generated wave of electromotive force.

Standard Meters :—I. A good meter should have a clear, legible scale, fairly uniform over the range, and not crowded at different points. II. It should be capable of being noted or observed at a distance. III. The resistance should be low. IV. There should be no tendency to overheat with the strongest current employed. V. It would be advantageous to avoid a shunt, if one milliampere can be read throughout the scale. VI. The instrument should be capable of indicating in all positions. VII. Any instrument whose indications depend directly upon the local magnetic force is objectionable, for the reason that its indications are liable to be affected by iron in the vicinity. VIII. The suspended system should require as little attention as possible, either for adjustment or shipment. IX. It is an advantage for the instrument to indicate with either direction of the current. X. Portability. XI. Liability to fracture.

Standard Electrostatic or Influence Machines:—I. Electrostatic machine best adapted to medical work, to be determined by its "output." Its output to be determined as follows: (*a*) At, respectively, 100 and at 150 revolutions per minute. (*b*) With two Leyden jars, each of whose outer metallic surfaces has the area of 4¼ × 1$\frac{1}{16}$ inches = 5$\frac{5}{16}$ square inches. (*c*) With discharging rods having ball terminals one inch in diameter and arranged respectively six inches and ten inches apart. (*d*) Give the number of sparks per minute which will pass between the discharging rods. II. Give the greatest maximum length of spark with machine arranged as in section I., except as to distance apart of the discharging rods. III. Give the maximum length of the brush discharge between the discharging rods with machine arranged as in section I., except that no Leyden jars are used. IV. Give the maximum length of spark that may be obtained by a brass ball electrode, two inches in diameter, from a person's back, seated in the usual manner upon an insulated platform—the platform connected to one prime conductor of the machine, the other being connected to the ground. (*a*) With above Leyden jars. (*b*) Without Leyden jars. V. Kind of electrostatic machine best adapted to medical work, whether a Holtz, Wimshurst, Toepler, Voss, Carré, Lewandowski, Toepler-Holtz, Wimshurst-Holtz, or machine not here named, provided the type as constructed successfully fulfills requirements outlined in section I. VI. Does the machine preferred easily reverse its charge ? Does it maintain its charge successfully ? VII. Facility and means of charging machine under all atmospheric conditions. VIII. Can a good meter to measure the output of the machine be suggested ? IX. Mechanical construction of machine. (*a*) Ease of actuating machine by motive power. (*b*) Durability of the mechanism causing the revolution of its plates. (*c*) Durability of its construction. (*d*) Is a glass case necessary ? X. The best means for drying the air within an enclosing glass case. XI. The best means for absorbing the ozone and nitrogen compounds formed within a glass case. XII. Is it not advisable to decide in a general way that no machine, the diameter of whose revolving discs is less than 26 inches, and the number of whose discs is less than six should be recommended by this committee for medical work?

Constant Current Generators and Controllers:—I. Primary batteries. Express preference and reasons therefor for a battery, voltage, modification and control of current strength, current generator, etc., etc. II. As to cells and secondary batteries. What are the defects and inconveniences ? What the advantages over other forms ? What the ampere hours, what the constancy, voltage and action ? III. As to dynamo currents. What the nature of the current, what its voltage, how it is modified by the form of controller under consideration ? IV. Report new forms of batteries and improvements, with claims as to superiority over those now in use. V. Rheostats. Tests, various forms and devices to modify and control currents ; difference in effect produced by each, mechanically, chemically or physiologically.

Standard Electrodes :—I. Inactive electrodes. 1. What is the best material in general for the ground-work of the electrode and what in special cases. 2. How may it best be connected with its rheophore ? 3. What is the best material to cover its conducting surface ? 4. When necessary, how may it best be insulated ? 5. In what way may it be kept warm and moist when not in use, should this be necessary ? 6. What should be accepted as standard sizes and shapes, and how best designated ? 7. What other points require to be considered ?

II. Active electrodes. 1. What is the best material in general and in special for the ground-work of the electrode ? (*a*) When used at the positive pole ? (*b*) When used at the negative pole ? 2. How may it best be connected with its rheophore ? 3. What is the best material to cover its conducting surface when necessary, in general and special ? 4. How may it be insulated when necessary ? 5. What is the form of construction where flexibility is required for tortuous canals ? 6. What shall be considered the standard shapes and sizes ; what scale shall be adhered to in considering the latter ; how may their surface area be estimated when they are of irregular shape ? 7. When designated by numerals as to size and surface, how may such best be expressed when stamped or otherwise marked on them ? 8. How may simplicity of construction be best obtained and cost of manufacture reduced without impairing efficiency ? 9. How may facility of cleansing and rendering aseptic best be achieved ? 10. What other points to be considered ?

III. Active and inactive electrodes.—1. Are the terms "active" and "inactive" the best standard terms we can employ ? 2. In the case of both active and inactive electrodes, should not the threads of ALL screws used in construction as a means of attachment, also all plugs and sockets, etc., be of a *standard* gauge, that electrodes might be used with attachments of all makes, etc., and to facilitate repair ?

POPE'S THEATRE, in St. Louis, it is said, can boast of a convenience which might be adopted with profit by theatres generally. The management of this theatre has given the purchasers of its seats telephonic communication enabling those attending the performances to be called quickly in case of necessity. By leaving their seat numbers in the box office, they can be called immediately.

ELECTRIC RAILWAY DEPARTMENT.

THE WHELESS ELECTRIC RAILWAY SYSTEM.

The Wheless conduit electric railway system is now in successful operation on a portion of the Washington & Arlington Railway at Washington, D. C. This road when completed will run from the National Cemetery of Arlington, across the Potomac River at Georgetown and into the heart of Washington; as overhead construction is prohibited by law in the City of Washington, the Washington & Arlington Railway Company has contracted with the Wheless Electric Railway Company for the use of the Wheless conduit system over that part of the road in the city proper. In the meantime a stretch of about three-quarters of a mile of the Wheless system is being used on the Virginia side for actual passenger service from day to day. The road so far completed extends from the Virginia terminus of the Aqueduct Bridge to the Military Post of Ft. Myer, in the National cemetery of Arlington. The overhead construction extends along this entire distance—about three miles—and three of the cars already running take current from the overhead trolley wire over the whole line. One car, however, Fig. 1, is fitted up to use either the Wheless system or overhead, and as a matter of fact takes current from the conduit over the first three quarters of a mile, changing to overhead after that distance has been accomplished. Orders for two additional cars similarly equipped have recently been given. It will be remembered that in the Wheless system an underground trolley in insulated sections is used, each section being active only when a car is over it, and then deriving its current from a lead-covered cable extending underground along the track. The conduit, shown in Figs. 2 and 3, is constructed with iron yokes, weighing about 180 pounds each and tied with 40 pound slot rails, the slot being seven-eighths of an inch wide. The depth of the conduit is about 16 inches over all and 17 inches in width (clear on the inside).

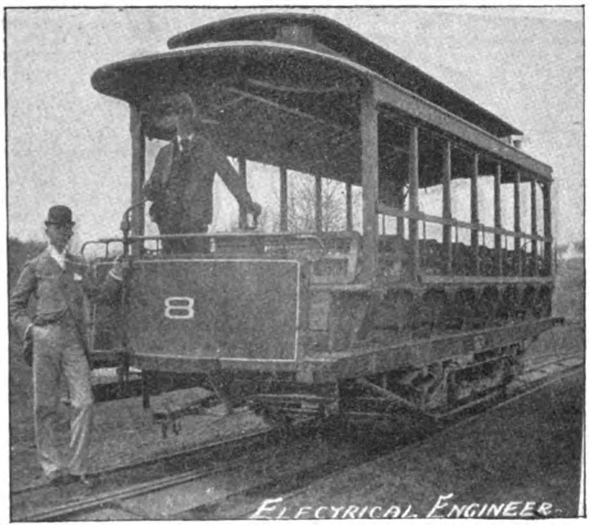


Fig. 1.—Car on Wheless Conduit Railway System.

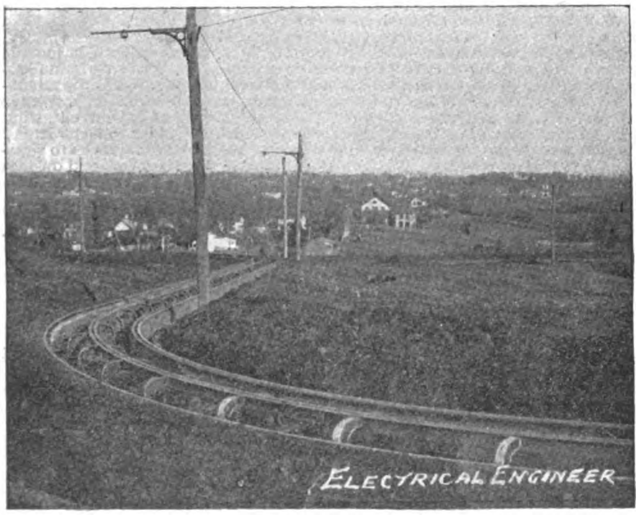


Fig. 2.—Curve on Wheless Conduit Railway System, Washington, D. C.

The trolley wire is in sections which may be of any suitable length; they are separated by an insulating coupler, which has a bed of slate used as a footing for the trolley.

The current is carried in a No. 0000 B. and S. G. stranded insulated cable. This cable is laid by the side of the track and is housed in a wooden casing of rough lumber laid on the ends of the cross-ties. The cable in this way lies within five or six inches of the side of the track. The terminal of this cable is connected to one terminal of the dynamo and the current is carried entirely in the cable. About every 200 feet a feeder is attached to the cable and passes into the iron switch box (Fig. 4), which sets in the track between the slot rail and the tram rail. This feeder is about three feet in length and is fastened to the cable, as already explained, by water tight lead-wiped joints.

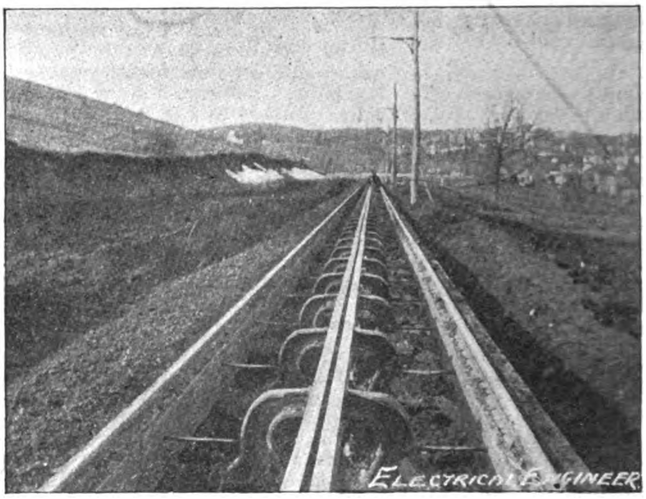


Fig. 3.—Track Construction, Wheless Conduit Railway System.

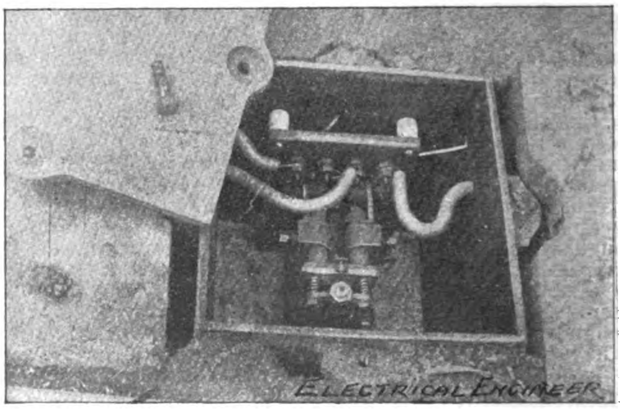


Fig. 4.—Switch Box Alongside Track, Wheless System.

The switch in the box is faced with carbon points and when closed lets the current across the points from the feeder to another feeder, which runs from the switch to the trolley wire in the conduit. When the armature is drawn down, the current can then pass from the cable into the trolley wire, and only into the one section. In the present instance the sections of trolley wire in the conduit average about 200 feet in length. The device which governs the entire operation of the system consists simply of two cells of storage battery which are carried under the bottom of the car. A connection leads from these cells to each controling stand on either end of the car. When the car is standing still (the controling stand being on an open circuit) the batteries are cut out, and when the controling stand is revolved so as to let in the main line current it first closes the local circuit in the storage batteries.

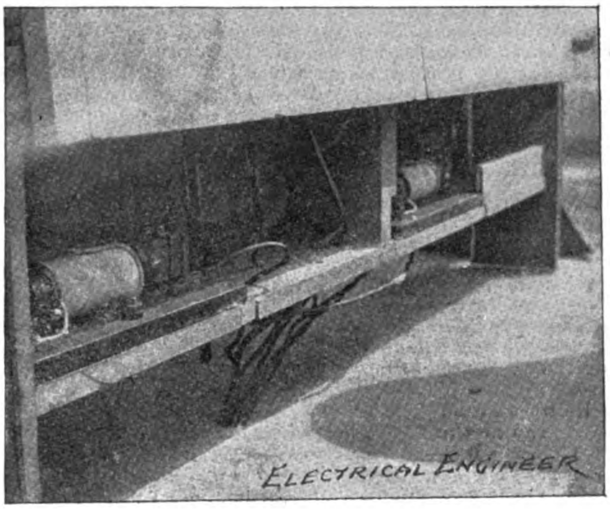


FIG. 5.—AUTOMATIC SWITCH ON CAR, WHELESS SYSTEM.

In this way the local circuit on the car is kept automatically under control by the motorman just as if he were running an ordinary electric car. When the controling stand is turned on to let in the current, the storage battery circuit is closed and the armature in the switch is drawn down and lets in the current from the cable to the trolley wire; the current passing across the carbon faces of the switch. As soon as the current from the main cable is thus let into the wire, it passes around a magnet on the car (placed under the front seat, Fig. 5) before it enters the motors, and vitalizing this magnet opens the local circuit. This is accomplished owing to the fact that the local circuit has an open point in front of the armature, and when the magnet is not vitalized this circuit is closed; but when the magnet is vitalized, as described, the local circuit is instantly opened. The object in opening the local circuit is to prevent draining of the storage cells on the car. One charge of the storage cells on the car lasts for several weeks, and they are connected in the circuit in such a way that the car while running is charging one of the cells, while the other one is in use.

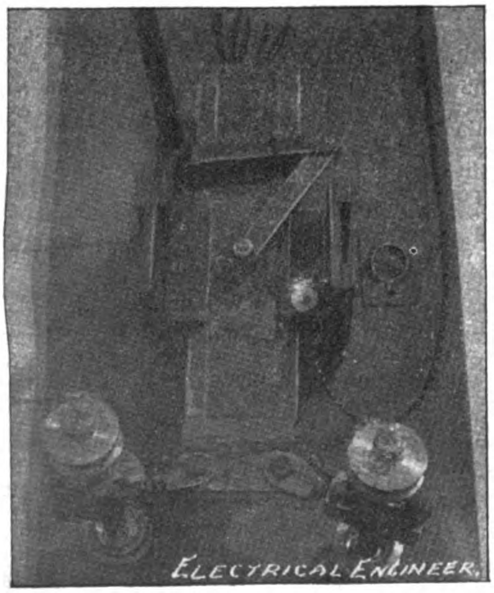


FIG. 6.—DOUBLE TROLLEY, WHELESS CONDUIT RAILWAY SYSTEM.

Our engraving, Fig. 6, gives a view of the trolley. It bears on the top of the wires and is entirely detachable from the car. It is supported on two steel guides resting on the truck frame of the car, the guides running crosswise of the car and allowing the trolley a lateral motion to adapt itself to curves. The curves on this road are very sharp, two of them being of 48 feet radius. The trolley wheels are supported on an axle which goes through one end of the trolley frame in the conduit and allows the trolley a downward play of about one inch and a half to adapt it to inequalities in the line. In this way the trolley has both a perpendicular and lateral play. The weight of the trolley shaft is about 50 pounds, and with the guides, about 100 pounds. The current is collected from the trolley by carbons which rest on the side of the wheel. The trolley used on the car now running has proven very efficient, and holds well to the line in the conduit.

The car is now in daily use, and up to the present no difficulty has been experienced in its ability to perform its work. Very accurate tests have been made to ascertain the amount of current required to operate the car on the underground system, and readings taken in the presence of responsible parties are here given; the readings comprise the work of the car on the underground system, and also the work of the same car with the overhead system. The numbers appended to the readings on the left hand side are the numbers of the sections. These sections vary in lengths over a track of about three-quarters of a mile in length. An average of the readings of both the overhead and underground work shows about 10 per cent. in favor of the underground work. The readings were taking with a Weston ammeter and are reasonably accurate. The pressure at the dynamo was 498 volts.

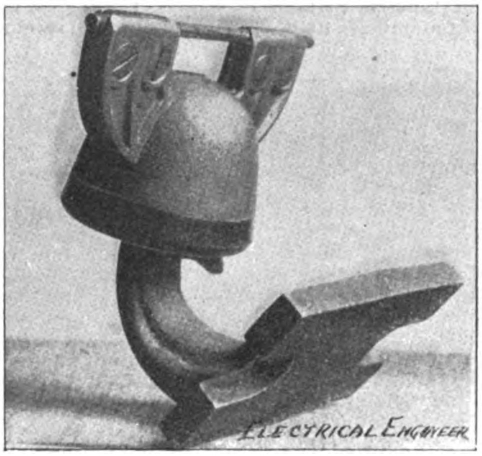


FIG. 7.—TROLLEY INSULATOR, WHELESS SYSTEM.

Nos. of Sections.	Underground Trolley.	Overhead Trolley.
1	25	27
2	22 to 30	23 to 30
3 (Curve)	40 to 45	40 to 46
4 "	40 to 30	25 to 45
5	21 to 37	30 to 45
6	22	24
7	25 to 45	24 to 48
8	42	41 to 53
9	12 to 14	16 to 20
9 (Curve)	25 to 35	26 to 35
	Average, 30 amp.	Average, 33⅓ amp.

The switches by which the current is cut into the trolley wire have been working now for several weeks, and none of them has required attention. Only one of the switches has been opened since the work started, and that one was merely for inspection by parties who wished to look at it.

Whenever the current is cut off by stopping the car for taking on passengers, or when the car is drifting, the wire in the conduit is not alive, and as a consequence no escape of current can take place. The car passes over the sections without interruption to the motors by the cutting of the circuit at the sections. A jerk on the motors is prevented by the trolleys being double-footed, so that the current from the section ahead is cut in before it is cut off from the section behind, when the car is leaving it. The carbon on the faces of the switch performs a very distinctive function, and constitutes the first use of carbon in this character of switches. Its purpose is to prevent the contact points from being welded together in case of the switches not closing up true or firm at any time. These carbon faces in the experimental work, which was done some two years ago, worked with splendid efficacy and have been adopted in the present system which is now carrying passengers.

By the arrangement adopted there is no way by which any section of wire in the conduit can be charged with current until the car runs on the section, and, in consequence, the wire in the conduit is at all times harmless to the touch. The current after passing through the motors is discharged through the rail as in any other electric system. In climates where there are heavy snow falls or ice accumulations on the rails, the return current can be sent through one of the wires in the conduit instead of by the rail, so that no impediment to travel occurs by the car not resting with metallic contact on the rails in snowy or sleety weather. By reversing the controlling arm the car can be run in the opposite direction, as the trolley travels equally well forward or back, and the car generally differs in no material sense from an overhead car.

The car, which is illustrated in Fig. 1 is equipped with two 20-h. p. motors; with motors of the new Edison design. On double track roads the switch boxes and main cable are placed between the tracks and the current is fed to either side. The iron boxes which contain the switches are about 12 x 12 x 14 inches deep, and are provided with removable iron covers of sufficient weight to stand the pressure of vehicles passing over them.

One of the staff of THE ELECTRICAL ENGINEER recently inspected the working of the system in Washington and was much pleased with the simplicity and smoothness of its operation. The conditions existing over the conduit stretch already in are certainly severe enough. The car starts at once up a 4 per cent. grade, then around a curve of 80 feet radius, then without any intervening level up a 6 per cent. grade and while on this ascent passes around a sharp curve of 50 feet radius and thence on to a 7 per cent. grade up to a level—the first level since starting. The automatic carbon-faced switches, which are 200 feet apart along the track, work beautifully and without a hitch thus far, notwithstanding recent heavy rains. These switches are contained in water-tight boxes along the track and can be readily inspected by removing the top of the box. This top is provided with a rubber gasket, and bolts on. Mr. Wheless proposes to keep track of the number of times each track switch is thrown by the passing of a car over its section, and to have photographs taken of the carbon faces "before and after" for the benefit of the skeptical. The wires from switch to cable and secondary trolley are lead-covered, and make a water-tight lead-covered joint at the cable. The trolley conductor is of No. 4 hard-drawn copper wire, and is supported on insulators such as that shown in Fig. 7.

At present the road is said to carry about 40,000 passengers per month—the business on Sundays being, of course, largest. The Secretary of War has approved the plans of the bridge across the Potomac, which bridge the company expects to construct in the near future. After crossing the bridge there will then be a stretch of three miles of electric conduit construction.

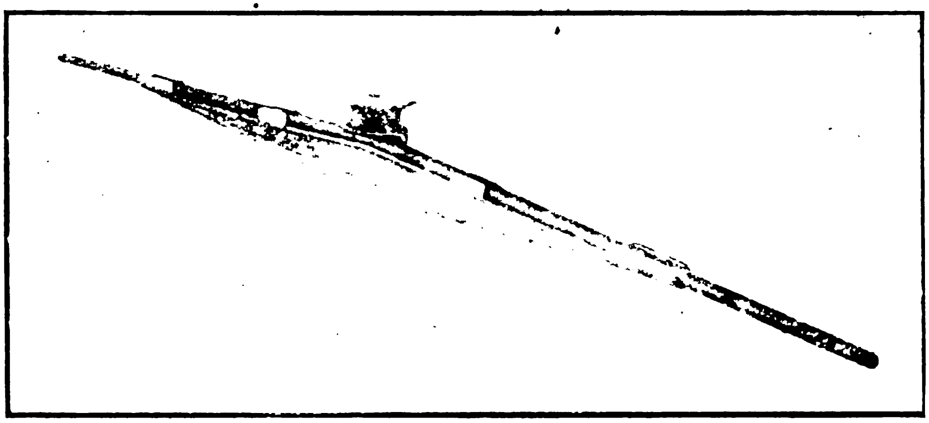
The power house is in Georgetown, corner of Thirtieth street N. W., and the Chesapeake and Ohio Canal. It now has 175 h. p. boiler capacity and 150 h. p. engine. This part of the plant was furnished by the Phœnix Iron Works Company of Meadeville, Pa. There is now in use one 100,000 kilowatt generator of the Edison type. The current is carried across the Aqueduct Bridge by No. 0000 feeders. Messrs. Woodbridge and Turner took the contract for the construction of the road; Messrs. Pepper and Register of Philadelphia were the consulting engineers and had charge of the entire construction work.

The Wheless Electric Railway Company has labored hard and long and has had many an obstacle to overcome in presenting to the public a piece of conduit road in actual operation; Mr. Malone Wheless, the inventor, Mr. Samuel Wheatley, the president of the company, Mr. King, president of the Washington and Arlington Railway, and their associates, are justly entitled now to look for the reward which is due their untiring efforts during the last two years. Whether Mr. Wheless has solved the problem of electric railway conduit construction, or not, ought to be soon determined. He and his active associates say they are only too willing to abide the test now confronting them.

THE SPILLMAN-SCRANTON TROLLEY EAR.

FOR some time past there has been in use on the electric railways in Columbus, O., a device for the support of the trolley wires, which has met with such unqualified success that our readers will be interested in a description of it. In all devices for maintaining the trolley wire above the track heretofore, the principle of suspension has been adopted, the trolley being held in position by clamps or grips of various types, some involving the employment of solder, and some without that accompaniment.

In the Spillman-Scranton trolley ear employed at Columbus, however, a new principle is employed, namely, that of *supporting* the trolley wire. This is carried out in the device shown in the accompanying engraving. As will be seen, the trolley wire is held in position resting in a substantial holder or ear, and held in position by the ears which are turned over the wire, the whole being, of course, suspended from the usual span wires. This method of support requires no solder, the contact being perfect, and since the ear itself is made of copper, it forms a perfect conductor.



SPILLMAN-SCRANTON TROLLEY EAR.

Another great advantage of this trolley ear is, that it requires only a small fraction of the time usually employed in putting up the ordinary trolley ear, so that it presents economy both in its lasting properties and in the cost of immediate application. After continuous use at Columbus for several months not one of these trolley ears has been known to come off.

This ingenious device is owned by the Columbus Trolley Ear Co., Grand Opera House Block, Columbus, Ohio.

ANOTHER LONG ELECTRIC ROAD IN JERSEY.

APPLICATION has been made at Elizabeth, N. J., to the Street and Law Committees of the city council by a new electric railway company for the franchise to construct a road from that city to Plainfield, passing through several townships.

Ex-Congressman John Kean, Jr., is said to be one of the prime movers in the undertaking to join the two principal cities in Union county by electricity. The company has ordered its cars and other paraphernalia for the equipment of the road, and feels sanguine of getting the desired permission. Several property owners on Orchard street, however, object to the railway passing through that street.

AN ELEVATED ROAD IN BOSTON.

THE legislative committee on Rapid Transit has completed the draft of a bill for an elevated railroad, following the general plan of the "Alley Elevated Railway" in Chicago. This route is to be by way of the alleys and narrow streets running from north to south between the North Union Station and Roxbury. The route as projected will be finished by the city, and it may be possible to avoid demolishing the City Hall.

LEGAL NOTES.

CHARGES OF LARCENY AGAINST THE GENERAL ELECTRIC COMPANY.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY entered suit at Pittsburgh on May 5, against officers of the General Electric Company, of Lynn, Mass., alleging that the defendants, through bribery and corruption of certain of the plaintiff's employees, have obtained possession of some of the Westinghouse Company's tracings, blue prints, drawings, specifications, letters, proposals, and other confidential information and chattels, particularly relating to and constructed by the plaintiff for the transmission of power by electricity at Niagara Falls.

Recently the Westinghouse and General Electric Companies submitted competitive plans for the power plant of the Cataract Construction Company at Niagara Falls. A short time later the Westinghouse officials were surprised to learn that the General Electric Company had withdrawn the plans first submitted, and had submitted new ones bearing a decided resemblance to the plans on which the Westinghouse engineers had spent months of hard work. This resemblance could only be accounted for on the theory that in some way the General Electric Company had procured copies of the drawings made by the Westinghouse engineers. Detectives were put on the work, and soon obtained evidence of underhand practice, supported by a large mass of original correspondence between the officials of the General Electric Company and their hirelings at Pittsburgh.

In connection with these astounding charges, arrest was made of Morris W. Mead, city electrician of Pittsburgh; Frank Carey and Joseph Butler. The two latter are employees of the Westinghouse Company, Carey as assistant draughtsman and Butler as night porter carrying the keys of the draughting room. Mead was released on $2,000 bail, and disclaimed any knowledge on the subject. The others at first went to jail. Mr. A. S. Carpenter, counsel for the Westinghouse Company, entered suit at the same time, for conspiracy, against C. A. Coffin, president, W. J. Clarke, M. H. Hamilton, E. W. Rice, Jr., and Walter H. Knight, employees of the General Electric Company, and officers have been sent to Boston and Lynn to serve warrants on them.

It is stated, definitely, that a large number of Westinghouse blue prints, etc., have been located at the Lynn factory of the General Company and that notice has been served on the General Company, that these things are stolen property.

It is claimed that Mr. Mead, was, in reality, a secret agent for the Thomson-Houston Company and that he acted as the adviser on the spot to young Carey.

The Westinghouse Company states that by means of a writ of replevin through their Boston counsel, Warren & Brandeis, search was made at the Lynn works, but that the two drawers in which the blue prints had been located a day or two before had been cleaned out, although every other drawer in the case was full of regular blue prints. Hence the notice served on the General Company to surrender the stolen property. A bill in equity, dealing with the matter, was filed at Salem, Mass., on May 6.

Mr. W. J. Clarke, of the General Company, was interviewed on the subject, on Saturday, by a reporter of the *New York Times*, and affected to make light of the charges. He is reported to have said that no company holds its blue points sacred, but hands them out to the first man who comes along as an ostensible customer.

Mr. C. A. Coffin is also stated, in a dispatch from Boston of May 7, to characterize the charges as false and malicious.

BELL TELEPHONE LITIGATION AT McKEESPORT, PA.

THE AMERICAN BELL TELEPHONE COMPANY has filed a bill in the United States Circuit Court, at Pittsburgh, against the McKeesport Telephone Company for an alleged infringement of a patent dated Jan. 30, 1877, for an improvement in electric telegraphs. The plaintiffs ask for a preliminary injunction.

Commenting on this suit, the *New York Times* says:—Not long after the expiration of the first of the Bell Company's fundamental patents, in March last, preparations for the establishment of competing telephone systems were made, and one of the new companies began operations in McKeesport, Pa., about two weeks ago. The Bell Company has promptly proceeded against this company in the courts for infringement. Of course it is not charged that the defendants are guilty of infringement with respect to the first of the patents granted to Bell, for that patent is dead. It is the second of the two fundamental patents that is involved, and this patent having been issued on Jan. 30, 1877, it has a little less than a year of life remaining.

The claims of this second patent are very comprehensive and have sometimes been described as covering the practical application of the principle or invention which was set forth in the patent that expired on March 7. The courts may hold that it is sufficient to preserve the Bell Company's monopoly until January next. But the Bell Company, after staving off for more than seven years a decision in the suit in which the Government asked that its first and most important patent should be declared null and void, should not insist upon the immediate suppression of these investors at McKeesport. It should give them a little time—say half as many years as it has taken in the case where it appears as defendant.

The patent upon which the Bell Company will rely after Jan. 30, 1894, is the patent issued to Berliner on Nov. 17, 1891. The Government also asks the courts to annul this, and it seems to us that it has a good case. We presume that the new Attorney-General will cause this very important suit to be prosecuted vigorously and without any delay that can be avoided.

ANNULMENT OF THE BELL TELEPHONE PATENT IN AUSTRIA-HUNGARY.

IN the suit brought by Carl Ekling against Alexander Graham Bell, the Imperial Ministry of Commerce in connection with the Hungarian Ministry of Commerce, has declared null and void the claims 3, 4 and 11 of the patent granted to A. G. Bell, on the 16th of December, the term of which, however, began on August 8, 1877.

The annulment was granted on the strength of the lapsing of the French patent which expired on July 15, 1888, and also on account of the Austrian patent which expired on the 16th of December, 1892, after having run its life of 15 years; for the additional reasons of lack of novelty, insufficiency of description, and the embodiment of an unpatented principle.

Claim 4, which is particularly characteristic as involving these reasons for the annulment, relates to a permanent magnet or other body capable of inductive action, in combination with a closed circuit so arranged that the vibration of one creates electrical undulations in the other.

THE RIGHT TO STRING TROLLEY WIRES IN NEW JERSEY.

VICE-CHANCELLOR GREEN has filed an opinion which affects the right of street railways to erect trolley wires. The three street railways in Paterson consolidated, and proceeded to erect poles and wires. James H. Grundy cut the wires in front of his house, and the railroads made application that he show cause why an injunction should not be issued restraining him from causing further damage. The Vice-Chancellor holds that while Grundy had no right to cut the wire, the injunction could not be issued.

In his opinion he says that when a public use authorized by law takes no property, but merely affects it by proximity, the necessary interference occasioned by such use furnishes no basis for damages. It must be an interference with the rights to light and air. The Vice-Chancellor decides that the court could not grant an injunction, because the railroad companies had not complied with the act of 1892 which requires that authority for stringing wires shall be obtained from the State Subway Commission.

ELECTRIC AND STEAM RAILWAY CROSSINGS IN CANADA.

THE principles of adjustment of the conflicting rights of electric and steam railway companies in crossing each others tracks, are well defined in a recent decision of the Railway Committee of the Privy Council of Canada. The question arose in the case of the Davenport (electric) Railway Company which had been granted permission by the Committee to cross the tracks of two steam railway companies, subject to the provision of the law that a railway company which desires to cross the track of another company shall provide and maintain at its own expense the necessary safeguards at the crossing. The Davenport Railway Company made application for an amendment of this ruling and contended that as it had been authorized by the municipal authorities to use the public highway in common with other vehicles, it would not be just to compel it alone to provide and maintain gates at the crossings which would protect as well all other vehicles using the highway.

It was held by the Railway Committee, as an equitable adjustment of the rights of all parties that the expense of the necessary safeguards should be divided equally between the electric railway company, the municipality and the steam railway companies.

ELECTRIC RAILWAY LEGISLATION IN CONNECTICUT.

ON April 26, the Connecticut State Senate debated for nearly three hours the general electric street railway bill, and finally passed it, 17 to 5. All the committee amendments were adopted and almost all others offered were rejected. An amendment requiring a majority of all directors of all street railway companies to be residents of the state prevailed.

The bill places control of all electric roads and street railways in the hands of local authorities, subject to the restrictions made by the railway commissioners regarding carrying freight and paralleling steam railroads.

This bill requires, of course, the consent of the House, and has not yet become law.

THE BELL COMPANY'S ANSWER IN THE GOVERNMENT TELEPHONE SUIT.

The American Bell Telephone Co. and E. Berliner have filed their answer to the bill lodged by the Government to annul the Berliner patent, in the U. S. Circuit Court for the District of Massachusetts.

The answer is a general denial of all the charges made in the Government complaint, and avers that due diligence was observed in the prosecution of the case in the Patent Office; that as a matter of fact the patent was ready for issue as early as 1882 and that the patent would then have issued but for the action of Examiner Brown, who rejected all its claims and raised other objections,—all of which could have been done before that date. This action was appealed from to the Board of Examiners-in-Chief, who, in February, 1889, reversed the decision of the examiner. It is also averred in response to the complaint that no new matter was introduced into the amended specification filed in 1880, after the acquisition of the patent by the Bell Company.

The Bell Company also aver that in the applications for the Berliner patent all due forms of law were observed, and that the Government cannot repudiate the acts of its own agents established by the laws creating the Patent Office.

THE INCANDESCENT LAMP SITUATION.

As might be expected, the recent decision in favor of the Columbia Incandescent Lamp Company in St. Louis, by which the General Electric Company was refused an injunction under the Edison lamp patent, has imparted considerable activity to the lamp industry, and reports come in from every quarter of resumption of work in old factories, as well as progress in putting new lamps on the market. Beyond this, little of any value can be said on the lamp situation that has not already been said many times over. Production of lamps is very large.

The Columbia Incandescent Lamp Company makes formal announcement of its readiness and ability to supply all customers with its well-known lamps. The American Electrical Manufacturing Company of St. Louis has made similar announcement, and now the Buckeye Company notifies the public that it has resumed the manufacture of its lamps. The Westinghouse Electric & Manufacturing Company has already increased the capacity of its "stopper" lamp works two or three times, but the demand from the World's Fair, on its contract of nearly 100,000 lamps, has kept it from filling many large, outside orders hitherto. The Packard factory at Warren is in full blast, and has, in fact, it is said, not intermitted at any time. Report has it that the Beacon Company will soon be ready to meet the situation.

Among the new lamps, we have already illustrated and described in The Electrical Engineer, the "New Sunbeam," the "Novak," the Benjamin, the Green, and one or two others; and this week we bring to notice the Voss lamp. Even this does not exhaust the list of new and possible lamps, for if the woods are not full of them, the Patent Office, the laboratories and the lamp factories are. He would be a poor newspaper reporter who could not nose out one new lamp a day in these times.

In regard to the suit of the General Electric Company against the Sunbeam Incandescent Lamp Company it may be stated that recent negotiations, to which the local Edison Company had consented, failed because of the unwillingness of the General Company to enter into the compact, which looked to a modification of the recent restraining order. This being the case, a motion for preliminary injunction is now to be argued but will not come up before July, it is stated.

In the U. S. Court for the Eastern District of Wisconsin, on April 17, the General Company asked for an injunction against the Electric Manufacturing Co. of Oconto, Wis., and for a restraining order against its officers T. A. Pamperin, J. B. Grunert and George Dyer. The restraining order was set down for hearing ultimately on May 5, but this has now been adjourned until June 1.

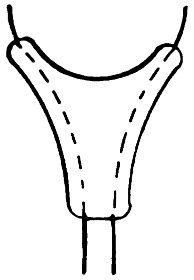
VETOING BROOKLYN FRANCHISES.

Mayor Boody of Brooklyn has vetoed the resolutions adopted by the aldermen on April 10, granting valuable franchises to the Nassau Electric Railroad Company, the City Railroad Company, and the Kings County Electric Company, on the ground that no pecuniary consideration was attached to the privileges.

The resolutions would have been amended at the special meeting of the aldermen by the insertion of a provision that $9,000 should be paid for each mile of streets, had it not been for the injunction granted by Justice Cullen preventing all further action on the resolutions pending his decision on the motion to make the injunction permanent.

It is now satisfactorily understood, so aldermen say, that no matter what the action of the courts may be in the pending litigation, no railroad franchises will be granted in the future in Brooklyn unless the city receives some adequate consideration.

THE VOSS INCANDESCENT LAMP.



The number of incandescent lamps designed not to infringe the Edison patent is constantly on the increase, the latest claimant for recognition being that of Mr. D. C. Voss, of 27 School street, Boston, Mass., whose new lamp is illustrated in the accompanying engraving.

The distinguishing feature of the Voss lamp and which is intended to avoid the Edison claim of an "all glass" globe or receiver, consists in the means adopted for sealing in the leading-in wires. Thus, the whole mount through which pass the platinum leading-in wires, is made of a solid material composed of a number of oxides of metals, and fused into the glass. Thus it will be seen that the lamp is very simple to make, and is not liable to leak, as the fusion between the glass and the mount is claimed to be perfect, and the oxide used is claimed to have the same coefficient of expansion as glass and platinum.

In making the lamp the oxide of metals is formed into the shape of a mount, as shown enlarged in the accompanying sketch, with the platinum wires included in it. The filament is then attached and the whole inserted in the glass bulb, the end of which is left open for its reception. The end of the lamp is then closed till there is left an opening just large enough for the upper end of the mount to fit into, and then the glass is sealed round it by fusion. The lamp is evidently not a stopper lamp.

In addition to the above, Mr. Voss states that he has patents on an iodide of aluminum filament which he will use in these lamps, though the method of sealing can be used with any style of lamp. A number of these lamps have been burning in Mr. Voss's office for a large number of hours, and they have proven very successful, apparently retaining their vacuum perfectly and showing a high degree of efficiency.

OBITUARY.

DR. JAMES BOWSTEAD WILLIAMS.

It is with feelings of great sadness that we record the death in this city, on April 26, of Dr. James Bowstead Williams.

Born in California, 38 years ago, Dr. Williams graduated from the California Military Academy at the age of 18, and had already while at that institute given evidence of considerable mechanical ability. Having determined to devote himself to the study of medicine, Dr. Williams entered the Medical College of San Francisco, where he pursued the full course. After graduating he gave much attention to electro-therapeutics and the application of electricity generally to the treatment of nervous diseases. In the pursuit of his studies he constructed with his own hands all the instruments used by him, in which work his mechanical and electrical ability was shown to a marked degree; this apparatus embraced a complete set of physician's electro-medical apparatus as well as electrometers and other high-grade testing instruments, and also an instrument for the accurate location of bullets in the human body. For a time, also, he was lecturer on electro-therapeutics in the Medical College of San Francisco.

His electrical studies having led him to the frequent employment of various insulations, Dr. Williams some ten years ago conceived the project of devising an insulation which should be free from the defects of those which he had found available in practice, and during this whole period up to his death he devoted practically his entire time to this object, the results of which will soon be brought to a practical issue. Dr. Williams' articles on "Insulated Electric Conductors," which have been running in the Engineer for some time past, give abundant evidence of his thorough and minute knowledge of the subject, and contain probably the best information on this subject which is available at the present time; and it is a matter of extreme regret that they should have come to a close by his untimely end. The admirable papers on "Oil *vs.* Air as an Insulating Medium," and "Tests of Wires," recently read before the American Institute of Electrical Engineers, of which Dr. Williams was recently elected a full member, will also be fresh in the minds of our readers.

In addition to his unquestioned ability in the field of his chosen work, Dr. Williams was endeared to his friends by his many amiable qualities, and his loss is the more deplorable, coming as it does on the very eve of the fruition of his long labors.

SIR JAMES ANDERSON.

Sir James Anderson died in London at an early hour Sunday morning, May 7.

He was born at Dumfries, Scotland, in 1824. For several years he was Commodore of the Cunard Line, and commanded many of its vessels. During the years 1865 and 1866 he was the commander of the steamship Great Eastern while the Atlantic cables were being laid. He was an intimate friend and business associate of the late Cyrus W. Field. Sir James was the first man to demonstrate that submarine cables could be recovered and repaired in deep water. For this achievement he was knighted by the Queen. He was possessed of marked engineering and navigating ability. He was instrumental in laying cables in all parts of the world, and was a leading director in several English cable companies.

Sir James was the author of "The Value of Submarine Cables in Time of War," "Government Purchase of Submarine Cables," and other works.

SOCIETY AND CLUB NOTES.

ANNUAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE annual meeting of the Institute for the reception of the yearly reports, the election of officers and other business proceedings will be held at the headquarters of the Institute, No. 12 West Thirty-first street, at 4 p. m., Tuesday, May 16. It is expected that this session will occupy about 2½ hours.

After adjournment, those who desire will assemble at "The Arena," 41 West Thirty-first street, where a subscription dinner will be served, the price of which has been fixed at $2.00 per plate; wine extra. This will be a purely social gathering.

The general meeting will begin at 10 a. m., on Wednesday, May 17. The following papers will be read:

1. "On the behavior of fuse metals in direct and alternate current circuits," by Mr. Charles P. Matthews, of Cornell University, Ithaca, N. Y.
2. "A modified Deprez D'Arsonval galvanometer," by Lieut. Charles D. Parkhurst, of Watervliet Arsenal, West Troy, N. Y.
3. "The variation in economy of the steam engine due to variation in load," by Prof. R. C. Carpenter, of Cornell University, Ithaca, N. Y.
4. "An automatic printing speed counter for dynamo shafting," by Prof. Geo. S. Moler, of Cornell University, Ithaca, N. Y.

At 1 p. m. a recess of one hour will be taken for collation.

The following papers will be read at the afternoon session:

5. "Practical aspects of electrical resonance," by Dr. M. I. Pupin, of Columbia College, New York city.
6. "The World's Electrical Congress of 1893," discussion of the provisional programme prepared by the Institute committee. This report with its appendices has been printed in the January and February issues of the Transactions, and absent members are earnestly invited to contribute in writing any comments they desire to make.
7. "A New Method and Apparatus for Measuring Conductivity," by E. G. Willyoung.
8. "High-tension generators for direct current transmission," by Prof. Francis B. Crocker, of Columbia College, New York city.
9. "The heating of armatures," by A. H. and C. E. Timmerman, of Cornell University, Ithaca, N. Y.

PITTSBURGH ELECTRIC CLUB.

AT the annual meeting of the Pittsburgh Electric Club held May 2d, the following were elected directors for the ensuing year: Morris W. Mead, Dr. Adolph Koenig, D. W. Dunn, John E. Ridall, G. H. Blaxter, John Campbell, H. P. Ecker and Albert Schmid. Secretary and treasurer, J. E. Hall. The Board of Directors organized and elected Morris W. Mead, president, John Campbell, vice-president and appointed Dr. Adolph Koenig, H. P. Ecker and E. F. Austin, House Committee; on Membership Committee, John E. Ridall, G. H. Blaxter and D. W. Dunn.

NEW YORK ELECTRICAL SOCIETY.

ON Friday, May 5, Prof. F. B. Crocker delivered a lecture before this society on "Dynamotors" and an abstract of which appears elsewhere in this issue.

The following gentlemen were elected officers of the Society for the ensuing year: President, Jos. Wetzler; vice-presidents, F. B. Crocker, Nikola Tesla, C. E. Emery, C. O. Mailloux, W. E. Geyer, W. J. Jenks, and M. M. Davis; treasurer, H. A. Sinclair; secretary, Geo. H. Guy.

ENGLAND'S GREETING TO CHICAGO.

DR. ELISHA GRAY, chairman of the Electrical Congress, has received the following cablegram from England:

Whitehall Club, London, May 5th, To Elisha Gray, Chicago:—

"The electrical engineers of England, dining together at their club to-night, desire to convey to their professional brethren in Chicago, sincere congratulations upon the opening of their grand exhibition. They hope to appear in person August next to support the success of your magnificent undertaking."

(Signed) PREECE.

DYNAMOTORS OR DIRECT CURRENT TRANSFORMERS.

ON the evening of May 5th, Prof. F. B. Crocker delivered a lecture on the above subject before the New York Electrical Society. In his opening remarks Prof. Crocker gave it as his most pronounced opinion that the importance of dynamotors as energy transformers or rather transferers, was not yet appreciated, and that the neglect of this type of apparatus was, to him, inexplicable, considering the numerous and easy methods of its applications.

The history of the dynamotor was a very beautiful one, showing a clear line of progress. Gramme in 1874 announced to the French Academy that he had a machine of this type in use, consisting of the arrangement now actually employed, that is, a single armature core having two windings each connected to a separate commutator. Cabanellas in 1881 also worked at the idea, and strange to say, seemed to prefer a vertical arrangement of the shaft. In 1883, Lane-Fox in England patented a system of conversion from high to low tension intended for general distribution. Zipernowski, Deri, and Edison in 1882, as well as others had worked on the subject; Edison, for instance, having suggested a method of converting from a two-wire to a three-wire system by this method.

Broadly speaking, the lecturer looked upon a dynamotor more as an apparatus for transferring electrical energy from one circuit to another than as an actual converter, as that definition met every case encountered in practice, whether the transference were from high to low, direct to alternate, or vice versa.

Prof. Crocker considered the dynamotor as almost identical in principle with the dynamo and motor. It introduced no new theories, but in actual practice in the construction of the apparatus, a few details had to be taken into account not met with in either of the other two types of machine. As to the methods employed in actual construction, three were evidently available. 1. A motor might be connected directly to a dynamo by shaft coupling. 2. A motor armature and a dynamo armature, each separate, might be mounted on the same shaft with each a field of its own. 3. A motor and dynamo armature winding could be mounted on the same core and revolve in the same field. The methods 1 and 2 had the advantage that one could regulate the secondary E. M. F., and if necessary, compound the two machines, since each revolved in its own field. The third method, employing but a single field, was the most compact and simple.

Among the phenomena met with in the operation of dynamotors was the fact that the point of commutation is exactly in the centre line passing between the pole-pieces, and remains so for all loads. As pointed out by Prof. Crocker, this becomes apparent when we consider that in the motor the armature reaction throws the line of commutation backward, while in the dynamo it is thrown forward. In the dynamotor the two armature reactions counterbalance each other and maintain the point of commutation rigidly at the theoretical point.

Passing on to the efficiency of such machines, Prof. Crocker pointed out the difficulty of making a machine of this nature of as high efficiency as that generally met with in dynamos or motors individually. It was evident that if the two elements of the machine constituting the motor and dynamo each had an efficiency of 90 per cent. which might be considered high, the efficiency of the combination evidently could not exceed 81 per cent.; but, if very carefully designed, Prof. Crocker thought that the combination could be brought up to 85 per cent. in large machines.

The advantages of this type of machine, however, were the reduced friction, the almost total neutralization of self-induction, the reduction in the cost of construction by making one field serviceable for two machines practically, etc., together with the undoubted special applicability of this type of apparatus to many purposes.

Prof. Crocker exhibited a number of dynamotors in operation; one for converting from 110 volts to 6 volts, taking 6 amperes at the dynamo side; the machine exhibited maintained a half inch electric light carbon continuously at a bright red heat, delivering in the neighborhood of 60 amperes. Another machine was shown transforming from 110 volts up to 500 volts, operating five 100 volt lamps in series; also a machine taking direct current at 110 volts and converting it into an alternate current which drove a small alternating fan.

The lecturer referred to the many uses for such dynamotors, such as the running of incandescent lights at 110 volts from 500-volt railway circuits; for electroplating; for telegraphy, where different E. M. F.'s are required; for the ringing of bells in telephony, etc. There are also instances where the transformer would be in the ratio of one to one; for instance, where it was desirable to take current from local electric lighting circuits, but where it was necessary to avoid grounding the central station circuit. The circuit leading from the dynamo end of the combination could, however, be grounded without danger. The lecturer also drew attention to their employment as "boosters," the main current being run right through the armature and increased in E. M. F. by the amount necessary to overcome the resistance of long feeders, etc.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED MAY 2, 1893.

Accumulators :—

Manufacture of Electrodes for Primary or Secondary Batteries, R. T. E. Hensel, Dresden, Germany, 496,517. Filed July 17, 1892.

The electrode consists of a metallic salt or oxide and a medium or cement comprising an acid, gelatine and an alkali.

Galvanic Battery, F. K. Irving, Brooklyn, N. Y., 496,658. Filed Jan. 27, 1892.

The plate is provided with horns extending laterally from one of its faces; the horns of one plate fit into the interstices of the other.

Element for Galvanic Batteries, A. L. de Méritens, Paris, France, 496,748. Filed Sept. 30, 1891.

The positive pole consists of lead combined with platinum, in the shape of platinized lead, perforated. The negative plate is zinc; the electrolyte is dilute sulphuric acid.

Alarms and Signals :—

Automatic Railroad Signal, W. Daves & W. H. Peddle, Roselle, N. J., 496,473. Filed Sept. 2, 1892.

Electric Alarm, H. F. Kolbe, Detroit, Mich., 496,690. Filed Nov. 14, 1892.

Relates to a locking mechanism for the bell hammer; especially applicable to bells used on locomotives.

Burglar and Fire Alarm, W. C. Dillman, Brooklyn, and G. A. Seib, New York, N. Y., 496,724. Filed July 11, 1892.

Electric Signaling Apparatus and System, J. W. Lattig, Easton, Pa., 496,786. Filed Dec. 27, 1892.

Consists in a method of operating railway signals by means of electric motors.

Electric Signal Apparatus, J. W. Lattig, Easton, Pa., 496,787. Filed Jan. 25, 1893.

Improvement on patent No. 456,380, Dec. 27, 1892.

Clocks :—

Magnet Armature, F. L. Gregory, Chicago, Ill., 496,648. Filed Nov. 16, 1892.

Magnet and armature of peculiar form having a high degree of uniformity of power in its various positions; intended for electric clocks, etc.

Conductors, Conduits and Insulators :—

Method of Anchoring the Ends of Wire, J. H. Brown, New York, N. Y., 496,636. Filed July 7, 1891.

The end of the wire is forced between the last preceding coil and an abutment.

Insulator for Telegraph Wires, R. G. Hemingray, Covington, Ky., and J. C. Gill, Muncie, Ind., 496,652. Filed Jan. 8, 1893.

Claim reads as follows: An insulator, provided with a series of teats at the lower edge of the insulator shield, to attract and gather at their points drops of water running down the outer surface of the insulator.

Distribution :—

Electric Lighting System, E. Thomson and E. W. Rice, Jr., Lynn, Mass., 496,455. Filed April 14, 1884.

Multiple series system of distribution with automatic switches for taking care of variations in number of lamps and current fluctuations of the generator.

Dynamos and Motors :—

Perforated Pole-Piece for Dynamo-Electric Machines, C. E. Scribner and E. C. Warner, Chicago, Ill., 496,449. Filed Feb. 7, 1890.

A constant current machine having consequent pole pieces cut away or perforated at the line of commutation; produces a uniform field independent of the direction of the rotation of the armature.

Commutator for Dynamo-Electric Machines, E. Thomson, Swampscott, Mass., 496,456. Filed Dec. 2, 1891.

Introduces a determined amount of self-induction between the armature coils and the commutator segments for the purpose of checking sudden rushes or reversals of current. The commutator is divided into several sections. Intended particularly for heavy current work and low potential machines.

Armature for Dynamo Electric Machines, W. Fritsche, Berlin, Germany, 496,514. Filed Dec. 2, 1892.

A type of disc or wheel armature with conductors arranged radially.

Controlling and Equalizing Electric Motors, D. Mason, Schenectady, N. Y., 496,522. Filed April 22, 1892.

The motors are provided with several field magnet coils which are simultaneously controlled; the coils of the several motors alternate and when the motors are in multiple the field coils of one machine are connected to the armature of another machine.

Utilizing Electric Motors for Operating Machinery, C. Hoffmann and E. Richter, Berlin, Germany, 496,567. Filed Nov. 7, 1892.

Claim 1 follows:

The combination with a power machine, of an electric motor and frictional transmission gear, the motor being movable in its relation to the power machine to modify the transmission gear and thereby vary the speed of the power machine without varying the speed of the electric motor.

Friction Coupling for Dynamos or Motors, E. Thomson, Swampscott, Mass., 496,710. Filed Dec. 10, 1891.

Armature Attachment, W. D. Packard, Warren, Ohio, 496,791. Filed March 25, 1892.

Provides an independent bearing common to the armature and commutator; the independent bearing being keyed to the rotary shaft of the dynamo.

Electrolysis :—

Electroplating Apparatus, S. C. Catlin, Bloomfield, N. J., 496,597. Filed June 6, 1892.

A holder for articles to be electroplated.

Lamps and Appurtenances :—

Electric Arc Lamp, F. Hansen, Leipsic-Reudnitz, Germany, 496,409. Filed Dec. 13, 1892.

Regulation is effected by means of a pivoted electromagnet acted on by a stationary magnet.

Electric Bunch-Light, J. Dillon, Larchmont, N. Y., 496,474. Filed June 22, 1892.

Electrode for Arc Lamps, J. F. Sanders and S. J. Sanders, Portland, Ore., 496,701. Filed June 15, 1892.

Consists of a combination of carbon, a light-giving metallic salt, a reducing agent, and a binder, the carbons adapted to be burned in contact with each other.

Electric Arc Lamp, J. F. Sanders & S. J. Sanders, Portland, Ore., 496,702 Filed June 15, 1892.

A lamp adapted to maintain the carbons accurately in contact.

Attaching Device for Electric Light Fixtures, G. Peeples, Philadelphia, Pa., 496,792. Filed Nov. 19, 1892.

Measurement :—

Electrical Measuring Instrument, E. Weston, Newark, N. J., 496,500. Filed Feb. 17, 1892.

Apparatus for indicating difference of potential: Consists of a permanent magnet, a vibrating loop conductor suspended between the poles, and means for making and braking an electrical circuit by the vibration of the loop. Intended for electrical protective systems.

Shunt for Electrical Measuring Instruments, E. Weston, Newark, N. J., 496,501. Filed Nov. 28, 1892.

A permanent-shunt to be connected with an electrical measuring instrument for obtaining a known difference of potential.

Voltmeter, A. H. Armen, Lynn, Mass., 496,678. Filed Sept. 8, 1892.

The index is in the form of a descending geometrical curve.

Electric Meter, J. Edmondson & J. Oulton, Bradford, Eng., 496,728. Filed Sept. 29, 1892.

A pendulum meter consisting of a vibrating contact maker and an impulse arm which impels the contact maker; an electromagnet and an armature lifts the impulse arm. Obviates the use of clock work.

Correcting Electricity Meters, J. Oulton & J. Edmondson, Bradford, Eng., 496,746. Filed Sept. 28, 1892.

Provides a supplementary coil or conductor in connection with the main coil of high resistance, the former carrying a fraction of the current to be measured for the purpose of making the register proportional to the current.

Electrical Testing Outfit for Cables, etc., E. W. Stevenson, New York, N. Y., 496,801. Filed Sept. 1, 1892.

A portable testing outfit of compact design.

Metal Working :—

Apparatus for Making Blanks by Electricity, G. D. Burton, Boston, and E. E. Angell, Somerville, Mass., 496,591. Filed Feb. 20, 1891.

The invention relates to the making of blanks for knife blades, forks, spoons, chisels, etc.

Working Brass by Electricity, G. D. Burton, Boston, Mass., 496,592 Filed Sept. 28, 1891.

Heats the interior of the bar, approximating to fluidity, maintaining the external surface sufficiently cool to preserve its form and homogeneous character; and then shaping or bending without breaking the skin.

Electric Forge, G. D. Burton, Boston, Mass., 496,593. Filed April 15, 1892.

The conductors for conveying the current are surrounded by cooling pipes or jackets.

Electric Forge, G. D. Burton, Boston, Mass., and E. E. Angell, Somerville, Mass., 496,594. Filed May 8, 1892.

The object of the invention is to provide a massive clamp capable of conducting heavy currents without itself becoming heated.

Electric Forge, G. D. Burton, Boston, Mass., and E. E. Angell, Somerville, Mass., 496,775. Filed Oct. 6, 1891.

The working terminals consist of tongues provided with contact rollers, and a sliding plate for supporting the tongues.

Miscellaneous :—

Musical Instrument, R. Eisenmann, Berlin, Germany, 496,402. Filed Jan. 21, 1892.

Vibrating strings vibrated by intermittent currents in electromagnets.

Electrically Operated Overhead Traveling Crane, W. H. Morgan, Alliance, O., 496,427. Filed July 22, 1891.

Consists essentially of an electrically controlled brake for the winding drum, and current controlling mechanism.

Locomotive Crane, W. H. Morgan, Alliance, O., 496,428. Filed Nov. 25, 1891.

A portable locomotive crane operated electrically provided with a movable counterpoise to balance the load.

Gravity-Brake for Vehicles, W. H. Morgan, Alliance, O., 496,429. Filed Nov. 25, 1891.

Provides a brake which operates automatically when the current is broken.

Locomotive Jib-Crane, W. H. Morgan, Alliance, O., 496,430. Filed May 10, 1892.

Method of conveying current from the overhead wires to the truck at any position of the latter.

Magnetic Crane, W. H. Morgan, Alliance, O., 496,432. Filed June 9, 1892.

A traveling crane with an electromagnet carried by a chain mounted on the drum for handling ingots, plates, etc.

Pillar Crane, W. H. Morgan, Alliance, O., 496,433. Filed June 13, 1892.

A jib crane operated by electric motors, having sliding contacts.

Electric Gas-Lighter, D. J. Quinn, Brookline, and P. W. Hoffmann, Boston, Mass., 496,618. Filed June 20, 1892.

The object is to prevent sparks being formed when shutting off the gas supply.

Gas-Engine Ignitor, D. Best, San Leandro, Cal., 496,718. Filed Dec. 27, 1892.

Fare-Register, S. C. Houghton, San Francisco, Cal., 496,688. Filed Aug. 15, 1892.

Railways and Appliances :—

Electric Distribution System for Railways, N. W. Perry, Cincinnati, O., 496,583. Filed May 27, 1891.

The object of the invention is to reduce the danger and liability to leakage of the working conductors.

Electric Locomotive, E. M. Boynton, West Newbury, Mass., 496,550. Filed Dec. 7, 1891.

The armature of the motor is attached directly to the web of the driving wheel.

Double-Pole Trolley, T. E. Adams, Cleveland, O., 496,631. Filed June 11, 1889.

Improvements in the details of construction.

Switches and Cut-Outs :—

Automatic Safety Switch, A. E. Hutchins, Detroit, Mich., 496,611. Filed Dec. 22, 1892.

Apparatus for cutting out circuits upon the breaking or sagging of the wire.

Electric Cut-Out, A. Wright, Providence, R. I., 496,807. Filed Nov. 9, 1892.

Electric Switch, A. Wright, Providence, R. I., 496,808. Filed Nov. 9, 1892.

Telegraphs :—

Printing Telegraph Instrument, A. H. Wirsching, Brooklyn, N. Y., 496,549. Filed June 8, 1892.

An instrument in which duplex type wheels and printing pads are combined with a single printing lever for acting on either of the pads.

Telephones and Apparatus :—

Electric Signaling Apparatus, S. D. Field, Yonkers, N. Y., 496,602. Filed Jan. 23, 1893.

Consists of a conductor supported in a magnetic field and mechanically connected with an "inharmonious vibrator," the apparatus being normally in a state of stress. Can be employed as a telephone.

Vibratory Telegraphy, S. D. Field, Yonkers, N. Y., 496,513. Filed July 30, 1892.

Means for maintaining a succession of rapid vibratory or undulatory electric impulses, raising the tension of such impulses by a transformer and varying the strength of such impulses by a transmitting apparatus in accordance with the signal to be transmitted, whether vocal or otherwise.

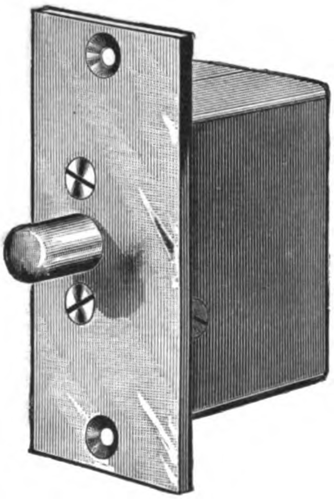
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE C-S FLUSH AUTOMATIC SWITCH.

The increase in the use of the incandescent electric light has developed a general inclination to adapt it to many special purposes, all, of course, tending toward greater convenience and efficiency, and the consequent demand of users for special appliances to perform special operations is often far ahead of the ability of those expert in the art to supply. No sooner is a demand of this character made known to the trade, than those interested in the production of such devices bestir themselves to meet the demand and supply the needed article. It is probable that in no other industry of the country has there been such stimulation to invention as in this particular field, and amongst those who are steadily and surely keeping abreast with the times in this regard is The Cutter Electrical and Manufacturing Company of Philadelphia which is well to the front with its well-known line of "C-S Specialties." A recent addition to this line of goods is a "Flush Automatic Switch" for use in bath-rooms, dark closets, etc., etc. It is shown here.

This switch is set flush in the rabbet of a door jamb in a manner similar to that employed with the familiar burglar alarm spring, and its action is strictly automatic in all that the term implies. Every time the door is opened the light is turned on and every time the door is closed it is turned off. Nothing can be disarranged by the accidental opening or closing of the door at the wrong time, consequently it requires no attention or adjustment whatever after it is once set up. This switch may also serve as an efficient burglar alarm, as an intruder is at once confronted by a bright light upon opening a door.



C-S Flush Automatic Switch.

Another convenient application is to attach it to the front door so that an occupant of a house, upon entering, finds a hall light to welcome him. Although this device has been but a short time upon the market it is already subject to an exceptionally flattering and steadily increasing demand from the trade. The newly erected New Netherlands Hotel in New York has already been equipped with several hundreds, and we are informed that many other prominent hotels and institutions are now being fitted up with this convenient device.

The cut shows the "Automatic" complete in its fire and moisture proof casing. The electrical arrangement and mechanical construction of this switch are practically upon the same lines as the C S Flush Push Switch which is so well and favorably known.

GENERAL INCANDESCENT ARC LIGHT COMPANY.

The above company, of 59 Duane street, this city, we are informed by its secretary, Mr. P. H. Klein, Jr., has taken the agency for the United States and Canada, for the arc light carbons and carbon brushes manufactured by the Fabrik Elektrischer Beleuchtungskohlen in Nürnberg, Actiengesellschaft, vormals Ch. Schmelzer. This will give the electric lighting public an opportunity to purchase the very best grade of imported carbons at prices which compare favorably even with domestic carbon rates; while, as is well known, these imported carbons are of very high quality giving a remarkable whiteness and steadiness of arc.

REGULATION OF PELTON WHEELS FOR ELECTRIC POWER TRANSMISSION.

The long-distance transmission plant of the San Antonio Light and Power Company, Pomona, Cal., has now been in successful operation for the past six months, transmitting a distance of 28 miles. The hydraulic part of this plant was installed by the Pelton Water Wheel Company, and one of the principal attributes to the successful operation of the plant is their new regulating apparatus, which, it is stated, controls the speed of the wheel perfectly under the most exacting conditions as to variation in load on the generators.

With this new system of regulation which has been developed by this company, the successful operation of any plant which they install is now assured. The regulating appliances heretofore used in connection with water-power plants gave but indifferent results.

Perhaps the most severe test that a water-wheel governor was ever subjected to is in the case of a Pelton wheel running a set of circular saws at the mill of the Red Cross Lumber Company, in the northern part of California. The wheel is operated under a vertical pressure of 485 feet. The saws require to drive them through the log at full feed 125 h. p. They take about seven cuts per minute, thus varying from full load, namely 125 h. p. to only what is required to drive the saws running free. During this operation the variation in speed is not perceptible.

One of the most valuable features of the regulator is that it is positive in movement and there is no danger whatever of its racing, thus admitting of its being geared so as to be extremely sensitive and to meet the requirements of electric railroad work, in which the changes are tremendous.

The Pelton Water Wheel Company, report an active business in their wheels and motors both from San Francisco and their New York branch. Among the recent installations made by them may be mentioned the San Antonio Light and Power Plant and the Redland Light and Power Plant, both in California. These plants are important on account of the long distance the power is transmitted—being 28 miles in the first instance and 12 miles in the latter.

The following installations may also be mentioned: Peoples' Light and Power Company Central Station, Aspen, Colo., 800 h. p.; New Plant of Roaring Fork Electric Light and Power Company, Aspen, 1,200 h. p.; Mining Plant at Crede, Colo., 200 h. p.; Mining Plant at Telluride. Colo., 800 h. p.; Central Station, Santa Ana, C. A., 400 h. p.; Central Station, Cartago, C. A., 200 h. p.; Mining Transmission Plant, The Moodies Co., South Africa, 500 h. p.; Mining Plant, Delamar, Idaho; Central Station, Walla Walla, Wash., 350 h. p.; Mining Plant, Cœur d'Alene, Idaho; Mining Plant, Philipsburg, Mont.; Mining Plant, India; Central Station, Japan; Mining Plant, Batopilas, Mexico; Mining Plant, New York; Honduras Rosario Company, C. A.; Mining Plant, Mexican M. & M. Co., Alaska, and Electric Plant, Belgium.

The new system of regulation perfected by this company adds particular value to their wheels for all classes of electric service. They are now making the wheels completely enclosed in iron cases; two of this class having recently been shipped to Chicago to operate in connection with the General Electric and Westinghouse Mining Exhibits.

They also supply the motors used on the system of the Hydraulic Power Company, London, who have extensive pipe-lines under a pressure of 700 pounds per square inch.

PHILADELPHIA NOTES.

The Phœnix Iron Works Company, Meadville, Pa., have just sold the Saginaw, Mich., Power Co., two 300 h. p. "Dick & Church" tandem-compound engines. These engines will each be coupled direct to a 200 k. w. generator. The Phœnix Co. have also sold the Wyandotte & Detroit River Railway another compound engine of 150 h. p. capacity, and have also closed a contract for eight horizontal tubular boilers for the street railway plant at Allentown, Pa.

NEW ENGLAND NOTES.

The Iona Manufacturing Co., manufacturers of electrical supplies and specialties, Mr. N. Marshall, manager, have just removed their factory to very much larger and more commodious quarters at 336 Congress street, Boston. By this change their capacity will be considerably more than doubled, which will enable them to take care of all orders hereafter with promptness.

WESTERN NOTES.

The Ansonia Electric Co. will soon be in better position than ever before to supply Wirt indicators and the standarized fuse links, as all testing, calibrating, etc., is now to be done in the new Wirt laboratory.

THE NESS TELEPHONE.

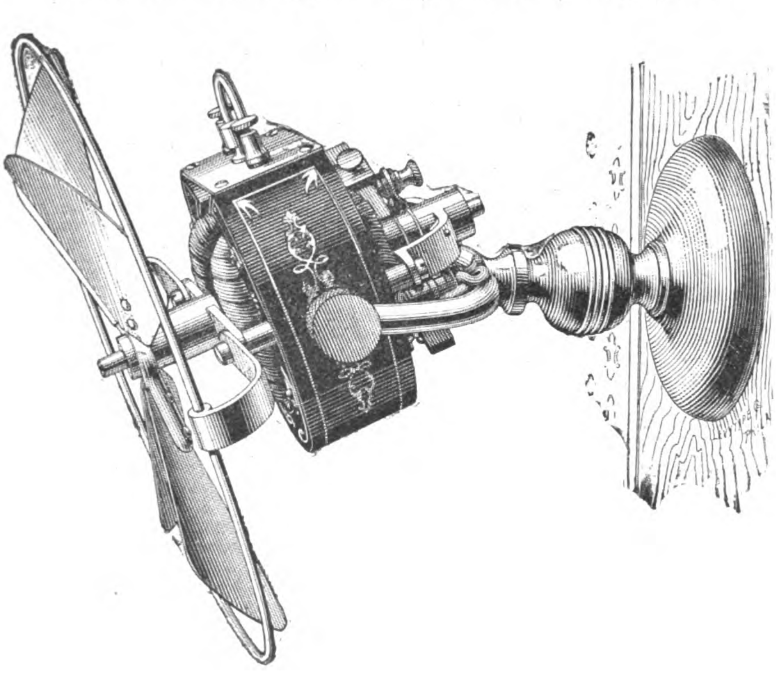
An exhibit of telephones has been sent to the World's Fair at Chicago by Mr. T. W. Ness of Montreal. Besides the ordinary telephones and switchboards for local exchanges, there is a variety of warehouse telephones for connecting the different floors of a factory or public building. Blake and carbon transmitters, receivers and annunciators are also shown, making a display of special interest at the present time when the patents on these articles are expiring.

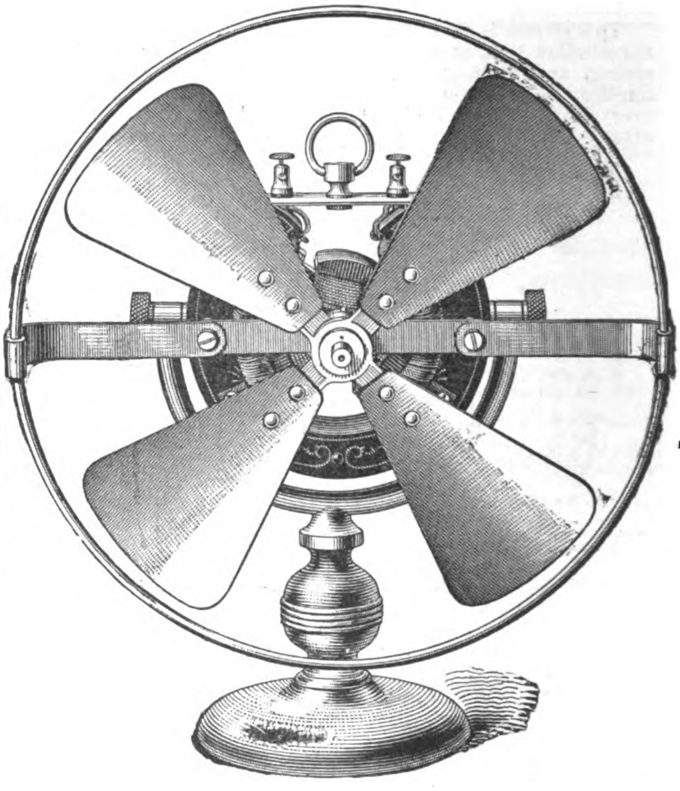
These are samples of the standard instruments which Mr. Ness has been manufacturing for the last three years. They are fully described in an illustrated catalogue which will be sent free on application.

THE NOVELTY ELECTRIC COMPANY'S ALTERNATING FAN MOTOR.

True to its name, the Novelty Electric Company, of Philadelphia, is constantly bringing out novel devices, and the most recent and timely is the alternating fan motor illustrated in the accompanying engravings. These fans are designed to operate on 52-volt alternating circuits, and take a current of only ⅛ ampere. The fan is nine inches in diameter and is protected by a 10-inch guard rim. It revolves at over 2,000 revolutions per minute.

A novel and valuable feature of the outfit is the variety of the positions in which it can be operated. As will be seen, the motor is mounted on a swivel joint which permits of its being operated on a table, hung from the ceiling, or fastened to the wall. In this way the effect of the breeze created can be utilized to the fullest extent according to the nature of the apartment.





"Novelty" Alternating Fan Motors.

The fan is provided with a brass base, polished and lacquered, and the spindle runs in phosphor-bronze bearings. The entire arrangement is most compact and ornamental. The company also manufacture a direct current fan outfit of similar proportions which is illustrated in our advertising columns.

COST OF HEATING CARS ELECTRICALLY.

We have received from the Consolidated Car-Heating Company of Albany, N. Y., an excellent table showing the details and total cost of steam and electric plants per horse-power necessary to generate and distribute electric current on a 500-volt circuit, and the cost of operating the Consolidated Car-Heating Company's electric car-heater. This table embodies the results reached by Mr. Chas. E. Emery, Ph. D., in his recent paper on the Cost of Steam Power, read before the American Institute of Electrical Engineers, and which gives the total cost per horse-power per annum with various types of engines on the market.

Mr. James F. McElroy, consulting electrical engineer of the Consolidated Car-Heating Company has calculated the cost of heating cars electrically with stations equipped for the various types of engine, and for various position of the switches. Taking, for instance, a station equipped with compound, high-speed non-condensing engines, we find that with coal at $3.00 per ton the cost of coal per hour for heating the car with the switch in the first position, giving 2.14 amperes, is .00756 cent; while with the switch in the fifth position, taking 12 amperes, the cost is .04272 cent. The heater, however, is usually operated at the third position, which meets the requirements of an external temperature of 20 to 30 degrees Fahrenheit, and at that point the cost is 0.2472 cent.

The table also contains valuable information on the cost per electric horse-power under varying conditions, and is especially applicable to electric railway and power work.

BROWN & SHARP MANUFACTURING COMPANY.

This world-renowned firm have just issued their new catalogue for 1893 containing no less than 306 pages; 58 more than the preceding one. This new edition has been thoroughly revised and rewritten, and contains the principal additions to the machines and tools regularly manufactured by the company; among these are the No. 2 and No. 3 Universal Milling Machine; No. 2 and No. 3 Plain Milling Machine; No. 1 Automatic Screw Machine; circular milling attachment, and a variety of other attachments for the rapid and accurate finishing of machine work. The catalogue will be mailed free to any address upon application.

POPE, READ & ROGERS.

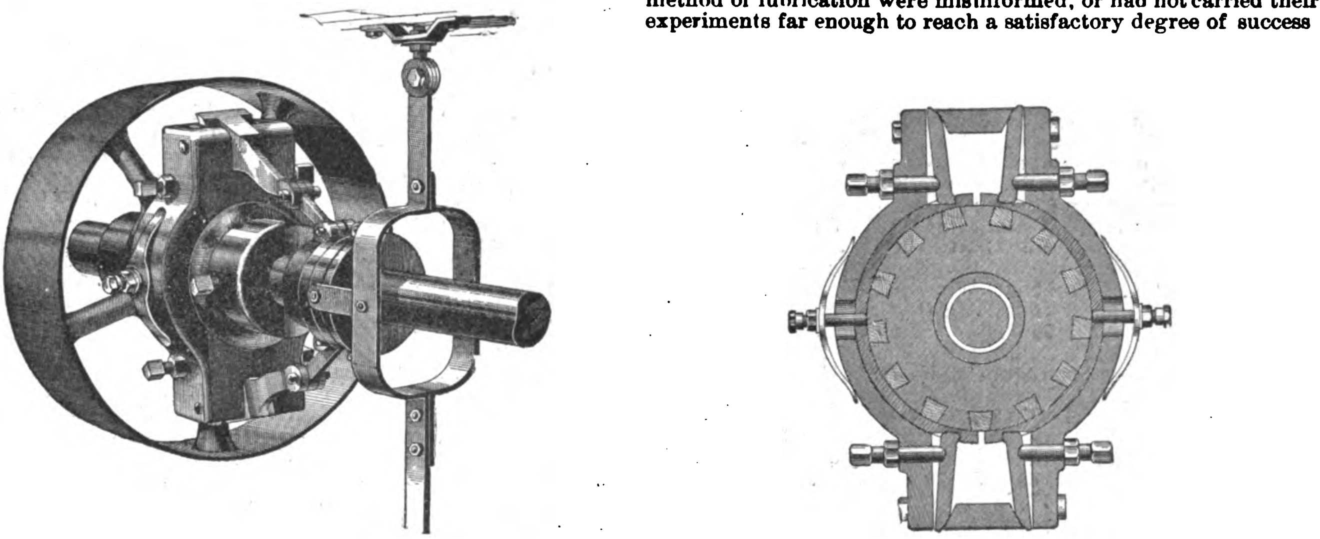
Mr. Franklin L. Pope announces that he has completed arrangements to resume the business formerly carried on by him in connection with the firm of Pope, Edgecomb & Terry, of attorney and solicitor in electrical patent cases. He has purchased the good-will and business of the *Electrical Review* Patent Bureau, which has been conducted for some years with marked ability and success by Mr. Robert H. Read, well known as an expert practitioner in the more difficult branches of electrical work, such as alternating and multiphase machinery and distribution, and has also secured the services of Mr. Read, who will hereafter be associated in business with him and with Edward H. Rogers, Esq., Counselor at Law.

The new firm of Pope, Read & Rogers have fitted up commodious offices in the new Monroe Taylor building, 41 Cortlandt street, New York, a location convenient and accessible to the business centre of the electrical industries, and have provided the necessary facilities for securing the prompt despatch of all business entrusted to their care. Parties desiring to procure adequate patent protection for complicated, difficult or particularly important inventions will find it profitable to avail themselves of the long and successful experience of the members of this firm.

HUB-FRICTION CLUTCH PULLEY AND CUT-OFF COUPLING.

The accompanying illustrations show the hub-friction clutch pulley and coupling in which is employed the principle of the flexible band-brake so familiar to all mechanics. In applying the principle for this purpose the hub of the pulley or coupling is increased in diameter and face and provided with insets of hard wood turned flush with the hub face, forming the most effective and durable gripping surface. The clutch shell carries within it a pair of half rings of forged steel, the ends of which are drawn together by a pair of strong levers, contained in the end chambers of the shell. The levers fulcruming on rounded points of steel screws and engaging-notches in the ends of half rings, are forced apart at the outer ends, drawing the lower ends together by means of wedges carried on the ends of levers outside of the shell, and these are operated by toggle-lever connections to a sleeve on the shaft. The operation of the combined system of levers and wedges draws the ends of the half rings together, contracting the half-circle and pressing their inner surfaces with great force on the face of the hub, holding it with an unyielding and locked-encircling grip.

All points of the contact surfaces have an equal pressure, which enables the use of a smaller surface to hold the load. It will also be noted that all points of these surfaces travel at the same speed, and hence the friction and wear are equal on all points of the surfaces. The speed of the friction surfaces is much less than with clutches which take their hold further from the shaft, and this reduces the danger of heating and wearing.



Hub-Friction Clutch Pulley and Cut-Off Coupling.

The friction surfaces are freely fed by oil cups, and the wood insets becoming saturated with oil afford sufficient lubrication for occasional neglect in oiling. The withdrawal of the half rings from contact with the face of the hub is effected by springs which draw them entirely free on the release of pressure by the movement of the shifter lever. These clutches can be thrown in and out at any speed up to 1,000 revolutions per minute, without shock or jar or heating.

These clutches are made any size up to 1,000 h. p. or more. Thousands of them have been sold in the past 15 years for the widest range of work in manufacturing, driving dynamos, etc., and have given general satisfaction. They are manufactured by the James Smith Woolen Machinery Company, Nos. 411 to 421 Race street, Philadelphia, who also contract for complete plants of machinery for transmission of power.

THE JACOBS AND MOORE ELECTRIC DISPLAY SYSTEM.

In this issue is described a unique electric display system for which a patent has just been issued to the inventors, Messrs. Jacobs and Moore. Mr. Chas. M. Jacobs is the prominent English engineer who has charge of the great work of tunneling both the East and North rivers opposite the lower portion of New York, in connecting Jersey City with Brooklyn, and also has in course of construction the tunnel under the East river at Seventy-first street, for the East River Gas Corporation.

Mr. D. McFarlan Moore is an electrical engineer who has frequently contributed to our columns.

Mr. Chas. A. Gundaker who has had a thorough experience in the incandescent lamp business with the Edison Company is also associated with them in exploiting these ingenious devices.

GRAPHITE BEARINGS FOR ELECTRICAL MACHINERY.

Articles from time to time have came under our notice on the subject of dry lubrication by what is getting to be pretty well known as the graphite method; the bearing and bushing being made of a combination of brass or bronze and a compound of graphite One of the writers at least condemns the idea in part and in whole about as follows: "Graphite and grease being mixed and put into a bearing the graphite separates itself from the grease and the grease has to do the work, hence nothing is gained; the graphite if used dry, is inconvenient, dirty and is soon reduced to a sooty powder without lubricating properties;" and adds that, "so far no genius has been able to discover a way by which the fine lubricating qualities of graphite can be utilized." Another writer says, "that while such bearings might succeed in very light work, where there is any pressure they utterly fail." And yet in the face of these arguments we know of one manufacturing company at least, the Graphite Lubricating Company, of Bound Brook, N. J., and there may be others, who have, in spite of frequent and serious discouragement continued their experiments until now they are turning out tens of thousands of these bearings and bushings each year; and we are credibly informed that many thousands of these bearings are in use where they are never oiled. and that, too, under light and heavy pressure and slow and fast speed. In thousands of cases where it is thought not best to trust to the graphite alone and recourse is had to oil, the quantity necessary is reduced to such a minimum as not to figure much in the bill of expense; and the working and wearing of the bearing is much improved.

We must therefore conclude that the writers against this method of lubrication were misinformed, or had not carried their experiments far enough to reach a satisfactory degree of success or had used in their experiments bearings manufactured by concerns who had not spent sufficient time and money to perfect their inventions. We believe that still more will be accomplished in this method of lubrication by the persevering and patient experimenter, while surely nothing can be expected from those who condemn all such efforts as baseless and fruitless.

In tackle blocks for vessels, in sheaves for derricks, ropeways and mining and electrical machinery, as well as many other kinds of apparatus, we have known these bearings to be very successful, and we trust the experiments will be pushed forward to still more complete success.

THE C. & C. ELECTRIC MOTOR COMPANY IN PHILADELPHIA.

We note, among recent extensions in the electrical manufacturing business, the establishment by the C. & C. Electric Motor Co., of 402-404 Greenwich street, New York City, of a branch office at 43 N. 7th street, Philadelphia. We also congratulate the C. & C. Company on their selection of a manager for this branch office, Mr. G. H. S. Young, previously connected with the Pennsylvania General Electric Company, at 509 Arch street. Mr. Young should be a valuable man in his new position from his experience in nearly every department of the electrical business, dating back to the early days of the Sprague Electric Railway & Motor Company. We also felicitate Mr. Young in being associated with such a well and favorably known concern. The C. & C. Company have greatly extended their line of goods and manufacturing facilities, made necessary by the large demands, and we understand they are now in a position to furnish complete electric light and power transmission plants in almost any size.

BIDS WANTED AT CHESTER, ILL.

The Chester Light, Water & Ice Company is now receiving bids on a central lighting station, to be constructed at once, at Chester, Ill. Proposals on the entire work, or any part of it, will be received until May 15, by Wm. H. Bryan, mechanical and electrical engineer, Room 56 Turner Building, St. Louis, where plans and specifications may be seen. The plant will consist of one 35-light arc machine, and two 500-light, 2,000 volt alternators, with engines, boilers, etc. Contracts have been signed in Chester for about 1,100 lights.

MR. FREDERICK A. SCHEFFLER.

Mr. F. A. Scheffler, so well and favorably known in electric light and power circles, who recently resigned as general superintendent of the Brush Company, of Cleveland, Ohio, has been appointed and accepted the position of General Sales Agent of The Stirling Company, manufacturers of the Stirling Water Tube Boiler, with office at 74 Cortlandt street, New York City. The Company is to be congratulated on securing the services of so experienced and able an agent as Mr. Scheffler.

A RECORD BREAKER FOR THE YEAR.

World's Fair Engine No. 999, a type of the most modern of the New York Central Railroad's locomotives, took the Empire State Express from New York to Chicago on April 28. She broke the record between the two cities. The speed recorder on the engine showed a speed of 86¾ miles per hour.

PHILADELPHIA NOTES.

Warren Webster & Co.—During the months of March and April, Warren Webster & Co., 491 North Third street, Philadelphia, Pa., manufacturers of the Webster vacuum feed water heater and purifier for utilizing waste exhaust steam, booked orders from the following firms:—Wm. Wood & Co., Philadelphia, Pa.; Aldrich & Wormstead, Buffalo, N. Y.; Boughen Engineering Co., Cincinnati, O.; J. G. Brill & Co., Philadelphia, Pa.; Hammond City Water Works, Whiting, Ind.; Oval Wood Dish Co., Traverse City, Mich.; Hotel Windsor, Bloomington, Ill.; John L. Roper Lumber Co., Norfolk, Va.; Geerin Brothers & Co., Cincinnati, O.; Philadelphia Gas Improvement Co., Philadelphia, Pa.; Oliver Iron and Steel Co., Pittsburgh, Pa.; Mr. E. S. Summons, Reading, Pa.; Water and Light Co., Nebraska City, Neb.; Armour Institute, Chicago, Ill.; Youngstown Street Railway Co., Youngstown, O.; Grosvenor Dale Co., Grosvenor Dale, Conn.; New England Electrolytic Copper Co., Central Falls, R. I.; Carnegie Steel Co., Munhall, Pa.; Luray Artistic Wood Co., Luray, Va.; Swift & Co., National Stock Yards, St. Louis, Mo.; Hoopes & Townsend, Philadelphia, Pa.; Swift & Co., South Omaha, Neb.; Ertell Brothers, Williamsport, Pa. They expect to move into their new works in about two months. They have descriptive catalogues, which they will be pleased to furnish to any address.

NEW ENGLAND NOTES.

The Redding Electric Company, of 41 Federal street, Boston, Mass., have just issued their illustrated catalogue of electrical specialties. Among these are the "Iona" hand gas lighting burner, with positive motion and the various Iona sockets, cut-outs for open and concealed switches, both exposed and flush. A colored page showing the Iona china switches gives an excellent idea of the beauty of these devices. We also find full descriptions of the electro-mechanical gongs and watchman's electric time registers of this company.

Portland, Me.—The new machine shop for the Eastern Forge Company, of Portland, Me., will be designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be 57 feet in width and 150 feet in length, and will be entirely of brick and iron with all modern improvements.

WESTERN NOTES.

Mr. A. D. Adams, General Manager of the Commercial Electric Company, of Indianapolis, was a recent Chicago visitor and called at the Engineer's Western office. Mr. Adams reports a most satisfactory business for his Company. Wonderful strides have been made, and although the Commercial Electric Company is but about seven months organized, it is to-day represented by very many motors and dynamos of its manufacture all over the United States. Very recent sales are reported from their agents for Ohio and Michigan, the Commercial Electric Company, of Detroit. This Company have just closed contracts for a 75 and 50 h. p. generator; a 50 h. p. motor and a number of smaller ones comprising machines of 5, 7½ and 10 h. p. each. The Ansonia Electric Company, Chicago agents for the Company, sold, last week, a 20 h. p. 500-volt motor for use in Chicago. Mr. Adams is justly elated over the wonderful success attendant upon the introduction of their apparatus.

Mr. J. A. Brett, formerly with the Sprague and Edison General Co., has been appointed superintendent of the Electrical Installation Co., of Chicago, with office at 912 Monadnock Building, where he will always be glad to receive his friends.

The Phoenix Iron Works Co. have removed their Western office, for the sale of Dick & Church engines, etc., from the Chamber of Commerce Building to 519 The Rookery.

George Cutter has moved to 851, 853 and 855 Rookery Building. The new offices, with an enlarged storeroom will enable him to take better care than ever of his growing trade.

"The American Mechanic" has removed from Minneapolis to the Gaff Building, Chicago. Mr. T. P. Pemberton, late of the *Master Steam Fitter* and *Stationary Engineer* is in charge as managing editor.

NEW YORK NOTES.

The Mica Insulator Company, 218 Water Street, New York City, report increased sales for their perfect micanite insulators. Besides the leading electrical manufacturers here and abroad who have adopted this improved method of handling mica, it is being used by the largest electrical street railway companies for repairing their motors and generators. Mica as an insulator is acknowledged by leading electricians to be equal, if not superior, to any insulating material now on the market. The advantage is seen at a glance when one can purchace Micanite insulators in any form ready to be placed in the machine without loss of time or material. Taking into consideration the great saving in cost over using mica in the regular sheet form, it will certainly pay anyone wishing the best insulator to investigate "Micanite."

Mr. Henry C. Townsend, the well-known patent lawyer, of Temple Court, this city, has associated with himself Mr. Delbert H. Decker, lately an assistant examiner in the Division of Electricity, U. S. Patent Office. Mr. Decker, acting under Mr. Townsend's immediate direction, will have charge of the branch of the business relating to the soliciting of patents. Mr. Townsend will now be able to meet the pressing demands on his time for Court work, opinions, interference cases, etc. His associate is a graduate of Cornell mechanical-engineering course, and a member of the bar. The new firm is strong in every way, and entitled to the fullest confidence of inventors and those interested in inventions.

The Wells & Coutan Co. has been formed by Messrs. O. Chan. Wells and C. A. Coutan, who have retired from the management of the New York house of the Crosby Steam Gauge & Valve Co., to engage in the manufacture of gauges. They have also been appointed sales agents for the various valves of J. E. Lonergan & Co. In the new concern, Mr. Wells is secretary and Mr. Coutan is treasurer. Mr. J. S. Cameron is president, and Mr. J. R. Gordon, superintendent, while the company has also secured the services, as salesman, of Mr. W. A. Locke, late of the Ansonia Brass & Copper Co. The offices of the company are located at 29 and 31 Gold street, this city.

Wood's New Adjustable Switch recently placed on the market by the Ansonia Electric Company, formerly the Electrical Supply Company, of Chicago, is made with adjustable tongues, which will allow it to be used as a right, left or diamond turn out. It is made very strong, of the very best material, and is quite an improvement over the ordinary switches.

The Conover Manufacturing Company, builders of air and circulating pumps and condensers, E. K. Conover, president and treasurer, have removed their offices to the Taylor Building, 39 Cortlandt street, where all communications in regard to their well-known specialties should be addressed.

The Consolidated Electric Storage Company will hereafter have its offices in the Edison Building, 44 Broad street, New York City.

NEW SUNBEAM LAMP.

Our readers should notice the claims made by the Star Electric Lamp Company on another page of this issue. They are very interesting to lamp users. The New Sunbeam is giving excellent satisfaction and users of incandescent lamps generally are showing their appreciation of the enterprise of the company in a most substantial manner by "orders," many of these being received daily. The facilities are now such that orders are taken for immediate shipment.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XV. MAY 17, 1893. No. 263.

THE CONDENSER IN ALTERNATE CURRENT POWER DISTRIBUTION.—III.

BY

William Stanley Jr.

IN order to accomplish the results described above, it is necessary to have a commercial condenser of extremely high efficiency. We are accustomed to consider a transformer which will re-deliver 97 per cent. of the energy applied to it as a very satisfactory and economical device, but the perfected condenser is far more efficient, as the total absorptive loss does not exceed 1 per cent.

Fig. 6 shows a condenser slab completed and ready for its tin case; two slabs are sealed in a narrow tin box or can and fitted with a wooden strip through which the two terminal wires extend, as shown in Fig. 7. In Fig. 8 is illustrated the condenser box, in which the tin cases (Fig. 7), are placed; each case is connected by wires to individual fuses placed in the fuse chamber at the end of the box. The dimensions of a standard case are approximately 8 x 12½ x ½ inches, and each case has a capacity of .7 ampere at 500 volts and 130 periods. A condenser box containing five cases has, therefore, a capacity of 3.5 amperes at 500 volts or 1,750 volt-amperes (at 130 periods), two such boxes being required to furnish the idle current for a 7 h. p. Stanley-Kelly motor. These condensers are operated at 500 volts potential, will continuously stand 1,000 volts without sensible heating (2 deg. C. above air), and appear to grow better and more efficient with age. Our condenser is a perfectly commercial instrument, by the use of which we have solved the problems of power distribution by alternate currents, completely and efficiently.

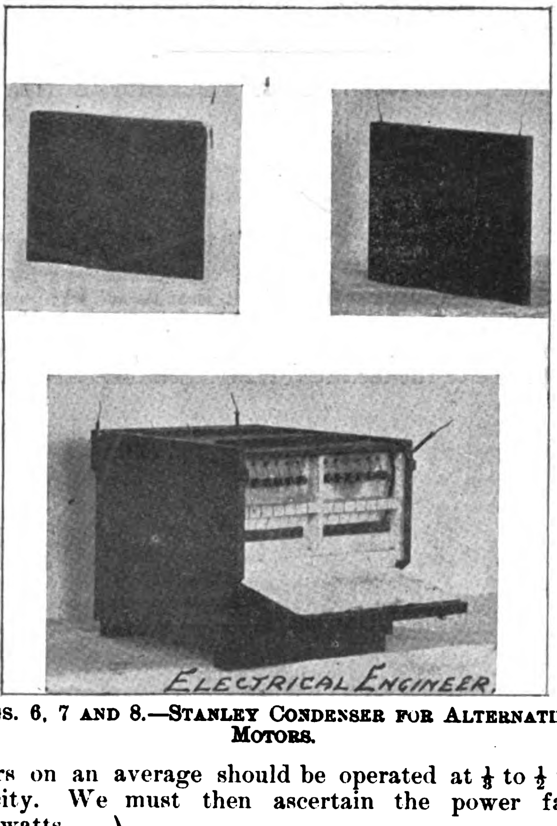
In order to illustrate the importance of our applications of condensers to the operation of alternate current motors we append the figures given by Mr. Dolivo-Dobrowolsky, describing the performance of one of his 3-phase motors:

5 H. P.—3-*phase*—DOBROWOLSKY A. C. MOTOR.

***Frequency* 50 periods per sec.**

Volts, per phase	60
Amperes, per phase, unloaded	15
Volt-amperes unloaded	2700
Amperes per phase, loaded	36
Volt-amperes loaded	6480
Actual work delivered, watts	3730
Apparent efficiency or power factor at full load	57 per cent.
Real efficiency	84 per cent.

These figures, which may fairly be taken to represent the modern practice in motor design in Europe, show first that the volt-amperes supplied by the alternator to the motor running free = 2,700, or that a 5 h. p. motor requires about 4 h. p. *generator and transformer capacity* to run it free.[1] At full load when delivering 5 h. p., or 3,730 watts, the generator and transformers have to furnish 6,480 volt-amperes, or 1.73 times the horse power delivered by the motors and 1.46 times the total watts supplied to the motor. Is this commercial? By putting condensers in parallel to the motors the volt-amperes at no load can be reduced from 2,700 to 900 without doubt, and at full load the volt-amperes required to operate the motor may be reduced from 6,480 to 5,000 or less. The figures above quoted, however, do not represent the working conditions of motors supplied from central station plants, for it is well known that the average load of motors connected to all kinds of work in cities (especially those operated by the larger Edison Companies) varies from ⅓ to ½ of their rated capacities; that is to say, the conditions require that the motors on an average should be operated at ⅓ to ½ their capacity. We must then ascertain the power factor $\left(\frac{\text{watts}}{\text{volt-amperes}}\right)$ for alternating motors at their leads.



FIGS. 6, 7 AND 8.—STANLEY CONDENSER FOR ALTERNATING MOTORS.

From the figures quoted above we may roughly calculate that at ⅓ load the power factor would be about .25 and at ½ load about .4, or that a station equipped with Dobrowolsky motors would have a continuous volt-ampere output two or three times the watt output; or again, that for every watt applied to a motor a volt-ampere would have to be put in circuit also. But if, on the other hand we apply condensers to the motors, in the manner described, the power factor or ratio of watts supplied to the motors to the volt-amperes in the line, is constant, and nearly perfect, namely, unity; it matters not if the motors be running free or half loaded or loaded to any extent, the supply system is called upon to furnish the true watts only, the condensers supplying the excess of volt-ampere to the motor magnets. Nor is this all, the data given by Dobrowolsky show that the currents in his motor lag about 43 degrees at full load; this lag will be increased by the self-induction of the alternator and of the circuit to at least 50 degrees.

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[1] The reference to Herr Dobrowolsky's motors must not be interpreted as a criticism on his work; on the contrary his motors appear to be carefully and correctly designed and the figures given are quoted for the sole purpose of illustrating the benefits derived by the use of condensers on motors already well known.

We know that the extra exciting power required to "keep up" the E. M. F. of an armature whose current lags 45 or 50 degrees is at least equal to the initial exciting power at no load or that the normal exciting power has to be doubled in order to compensate for the fall of E. M. F. caused by the demagnetizing action of the lagging armature current. But if we double the exciting power, we radiate four times the heat from the field and if we call on the armature for 1.4 times the energy current we radiate twice the heat from the armature wire. Assuming the hysteretic and Foucault losses constant, then, it is evident that to make up the fall of potential at the alternator terminals due to the lag of the currents delivered we must radiate approximately three times the heat from the machine that would be radiated were it working on an ohmic resistance, instead of a self-inductive circuit.

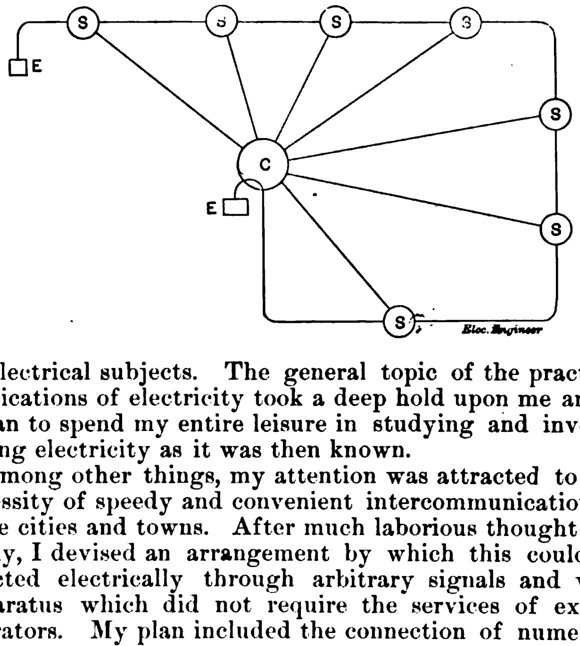
The lag of the armature current is, therefore, a "thing to be avoided," for, to sum up, the current lag in the system increases the size and cost of the supply apparatus, increases (indirectly) the temperature of the generator and causes fluctuations of the E. M. F. in circuit. All these troubles are greatly reduced by introducing condensers at the motors to supply the false currents unavoidable in inductive motors.

REMINISCENCES OF EARLY TELEPHONE DAYS.—I.

BY

F. E. Kinsman.

In the year 1875, I was a clerk in the well-known gun store of William Reed & Sons, Boston, Mass., and through the influence of Mr. Romney, chief clerk, was induced to attend some of the lectures given at the Lowell Institute on electrical subjects. The general topic of the practical applications of electricity took a deep hold upon me and I began to spend my entire leisure in studying and investigating electricity as it was then known.



Among other things, my attention was attracted to the necessity of speedy and convenient intercommunication in large cities and towns. After much laborious thought and study, I devised an arrangement by which this could be effected electrically through arbitrary signals and with apparatus which did not require the services of expert operators. My plan included the connection of numerous points to a central office or station, each through a separate wire, and an additional wire connected with and through all the outlying points and terminating at the central office, being grounded (to save wire) there and at its distant termination. This additional wire was to be used for calling signals. My proposed arrangement of circuits is sufficiently indicated in the accompanying diagram.

Having become thoroughly convinced of the practicability of the undertaking, I took my plans to Mr. Charles Williams, Jr., of Boston, an electrical instrument manufacturer, who undertook to construct the necessary apparatus under my direction. During the time that I spent in working up my plan for municipal intercommunication, I made the acquaintance of Mr. A. L. Russell, then superintendent of Mr. Williams's factory and now head of the electrical manufacturing firm of A. L. Russell & Co., of Boston. He displayed much interest in the undertaking and gave me many valuable suggestions in connection with its development. During one of our interviews, Mr. Russell asked me if I had ever heard or seen a telephone. The answer that I never had brought out from him the information that a telephone had been invented and that an experimental telephone was then in the office of the factory. Mr. Russell further said that at the conclusion of experiments then in progress he would show the telephone to me. Well do I remember its appearance and my surprise at the apparent insignificance of the details of its construction. It seemed to be nothing but a rectangular box with a hole cut in one side over which was stretched a diaphragm of gold-beater's skin, upon the centre of which was mounted a small piece of soft iron. Inside the box and directly back of the diaphragm was an electromagnet. At first I was inclined to be skeptical; but upon being told by Mr. Russell that he had actually heard it reproduce sounds from a considerable distance, I speedily came to the conclusion that any electromechanical arrangement that I was then able to produce for arbitrary signaling would be wholly inadequate to compete with a successful telephone. I was so much impressed by what I saw that I immediately ordered the discontinuance of work on my signal apparatus and began to plan for securing an exclusive right to use the telephone for municipal intercommunication; I wrote to Mr. Saunders at once, requesting an interview for the purpose of considering the terms upon which I could secure the telephone for this purpose. Mr. Saunders referred me to Mr. Hubbard, who was spending the winter in Washington. This was in the winter of 1876–1877. After some correspondence with Mr. Hubbard I was requested by him to detail the use for which I wanted the exclusive right to use the telephone. I accordingly made known to him my scheme for connecting a large number of instruments, variously located, to one central station for intercommunication, and disclosed my plan in detail for a telephone office which would radiate the telephone lines to the various users, including devices through which the person in charge of the general or central office could make connections between the lines of users.

It will be perceived that this was the essential element embodied in the now almost universal method of telephonic communication. Mr. Hubbard assured me that such an arrangement was entirely new to him and to his people, and that he would soon be in a position to treat with me in respect to terms of a contract for the exclusive use of the telephone in connection with my system. During the early spring of 1877, Mr. Hubbard notified me that he was ready to negotiate and I immediately proceeded to make, and did make, arrangements to secure an amount of capital sufficient to start my enterprise in Boston. A contract was soon after drawn up between the owners of the telephone and myself, together which my capitalist associate, by virtue of which, if it had been consummated, my partner and myself would have secured the exclusive right to the use of the telephone for our purpose, viz.: intercommunication between a central office and private users, and between the users through the central office. Although terms had been substantially agreed upon between us, the contract failed of execution, for reasons that I have never been able to ascertain. I have always felt that I had a right to this consummation. Its failure caused me a bitterer disappointment and a more profound depression than I ever experienced before or since.

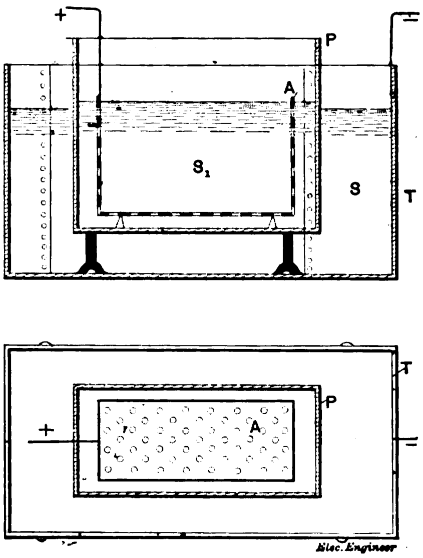
THE PREPARATION OF GELATINOUS ELECTROLYTE FOR STORAGE BATTERIES.

BY

Dr Paul Schoop

One may safely say that a good accumulator for portable work is more difficult to construct than one for stationary work. The life or durability of the cell, especially of the plates, depends a good deal on the thickness (or weight) of the plates. While the weight is no serious objection with a battery for central station lighting, it is a very great obstacle in batteries for tramcar-propulsion, electric launches, locomotives and train-lighting. How to reduce the weight without sacrificing the durability, is the main problem to be solved with this type of cells.

Another point is, to provide containing vessels or jars which shall at the same time be light, solid and cheap. As yet only the hard-rubber cell has proved satisfactory as regards weight and other qualities, but its high price is still an important objection. The cell must be well closed by a suitable cover and the two terminals, extending through the cover, ought not only to be free to move electrically, but must not destroy the watertight property of the cover. This point, as well as the arrangement of the plates, which must afford security against violent jerks, is a matter of construction. The so-called "series-cell," in which each plate forms a separation-wall between the electrolyte and the cathode on one side and the anode on the other side, is not, and probably never will be, practical, for reasons into which we will not enter at present.



Preparing Gelatinous Electrolyte for Storage Batteries.

If the principle of a water-tight cover is followed, the direct inspection of the cells by the eye is not possible; the readings of the voltmeter alone allow of controlling the condition of the cell. In case any short-circuit has occurred by detached active material, the cell has to be opened, dismounted and again put together, which means considerable expense. The substitution of the dilute sulphuric acid by gelatinized acid is therefore a considerable advantage, since short-circuiting by dropping material is avoided. The cell with gelatine is indeed more reliable for all portable work than the same cell filled with liquid acid. As is well known, the capacity of the ordinary type of cell diminishes if filled with gelatine, according to the construction of plates, from 10 to 30 per cent. The Tudor plates only show a decrease of 10 per cent. of their capacity.

Attempts have often been made to run tramcars by open cells without cover and with dilute ordinary acid; any one with experience knows what happens, in case the car is suddenly stopped in any way. Electric launches are still more difficult to handle with dilute acid. These difficulties are overcome by the use of the gelatinous electrolyte. The preparation of the gelatine, though very simple, still requires the application of a few wrinkles, since the durability of the cell filled with gelatine mainly depends upon how the electrolyte has been prepared, and on the purity of the materials used. In consideration of the importance of this gelatinized acid for portable cells, the writer here gives an exact and practical description of its method of preparation.

The materials to be used are: 1. Dilute sulphuric-acid of 1.22 specific gravity. 2. Dilute silicate of soda of 1.20 specific gravity. 3. Asbestos fibre.

The sulphuric acid is preferably prepared by distilling a mixture of three parts distilled water with one part of concentrated sulphuric acid, whereby a dilute acid of about 20 per cent. is obtained. This acid must have no metallic impurities (platinum, arsenic, antimony, etc.); of course it must be free from chlorine and nitrogenous compounds.[1] The writer has found by practical experience that it is difficult to get pure acid in the United States.

Silicate of soda always contains chlorine; to obtain it pure it is treated as follows: An iron tank T, contains the mixtures, of one volume of silicate of soda (1.40 specific gravity) with one volume of distilled water of 1.20 specific gravity. A porous clay pot P (of the same material as the porous cups in galvanic batteries) is placed within the iron tank, distant from every side of the tank about five inches. This porous clay pot is filled with a mixture S_1 of one volume of the aforementioned solution of silicate of soda with one volume of caustic soda of 1.25 specific gravity. An iron-sheet A rests on porcelain insulators inside the porous pot and serves as the anode, while the iron tank constitutes the cathode. Care must be taken that the liquids inside and outside of the porous pot are at the same level. If now a current is passed through this electrolytic vessel, all chlorine goes to the anode and is immediately absorbed by the alkaline solution surrounding the anodes. After 24 hours the water-glass solution is free from chlorine and is taken off for use. The iron tank is again filled with the solution and the process carried on again.

The asbestos fibre is obtained by boiling asbestos millboard with dilute sulphuric acid of 1.10 spec. grav. for two hours; the millboard disintegrates into a fine regular pulp and, according to the quality of the asbestos, more or less of it is dissolved.[2] The pulp is then filtered, washed with a little distilled water, gently pressed and is then ready for use.

It would be trespassing too much on the space of this journal to give the reasons for these preparations, but they are absolutely necessary to attain success. The author knows of some who tried the "gelatine" in the United States and found it accompanied by "drawbacks;" he believes that this description will enable everybody to get good results. In this as in other cases, work half understood cannot give good results; and it may be remarked here that cells of bad manufacture originally will not be converted into good ones by merely applying gelatinized sulphuric acid.

Having now procured the pure materials the gelatine is prepared as follows:

Four gallons of dilute sulphuric acid (1.22 spec. grav.)

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[1] The presence of chlorine is detected by adding to half a pint of the distilled acid, some drops of a solution of nitrate of silver (5 per cent.); the mixture must remain clear. Nitrogenous compounds, like nitric acid and nitrous acid, are discovered by adding to $\frac{1}{10}$ of a pint of the distilled acid the same volume of chemically pure concentrated sulphuric acid, allowing the mixture to cool, and then adding a few drops of a solution of one part diphenylamin in 10 parts of concentrated sulphuric acid; a dark blue color is developed, even if there are minute parts of nitrogenous compounds present.

[2] The millboard should not contain paper pulp; its presence is clearly proven by heating a piece of millboard over a Bunsen burner or some glowing coals. Pure asbestos remains white, while an addition of paper pulp will blacken the millboard.

are poured into a glass or ebonite vessel, one pound of asbestos fibre is added (of the wet, gently pressed stuff, which contains about one-third to one-half its weight of water), and the acid is now stirred up with a wooden rod, till the asbestos is evenly distributed in it. Then one gallon of water-glass (1.20 spec. grav.) is *quickly* poured into the acid and the mixture stirred again. The mixture is perfectly fluid like ordinary dilute acid and should not contain lumps of silicious acid.

It is now, especially if made for the first time, advisable to slowly and continually stir up the mixture till it gets thicker; after an hour, or sometimes even longer, the mixture assumes an oily appearance, like concentrated glue. Now is the time to pour the mixture into the cell and to let the cell stand quietly for 24 hours. Before filling it up with gelatine, the cell must be filled with ordinary dilute acid of 1.20 spec. grav., in order that the dry plates may become impregnated with acid; immediately before pouring in the gelatine mixture, the acid is drawn out of the cell. After a few hours the mixture becomes stiff and is no longer fluid; after 24 hours the cell may be turned upside down without anything falling out of the cell.

It would not do to pour the gelatine mixture into the cell soon after its preparation, and it would be still worse to apply it to dry plates. Some part of the too fluid mixture would penetrate into the porous active material of the plates, and later, when over-charging, the gas bubbles would force their way right through the gelatine and split it up. If properly applied, the gelatine forms an elastic, stiff layer between the plates, but lets the gas bubbles escape *between* the surface of the plates and the surface of the gelatinized acid.

In charging the cell, it will be observed that some acid is formed on the surface of the gelatine; during the discharging period this acid disappears and is again taken up by the plates. In order to keep the gelatine elastic and unchanged, it is necessary to provide for a constant little layer of liquid on top of it. If the cell were to be used without this precaution the gelatine would be deprived of water in the course of the overcharging of the cell and get dry and would shrink; the internal resistance would increase and the capacity of the cell would decrease. The gelatine is perfectly indestructible and stands the action of acid or the current as long as a glass jar or ebonite vessel.

The internal resistance of the gelatine is just about double that of dilute sulphuric acid of 1.20 spec. grav. A cell having, for instance, 0.001 ohm resistance, if filled with dilute sulphuric acid, will have 0.002 to 0.0025 ohm resistance with gelatine. This increase is so trifling, that it need not be taken into account in most cases, especially with portable batteries. Of course the efficiency will be lower with gelatine, owing to the increased resistance; in general one may state, that the efficiency as an average is decreased about 5 per cent.

There is also a field for the gelatine in stationary lighting batteries, in fact, wherever proper attention to the battery is doubtful, as in the lighting of villas, steamers, etc. The people who are usually charged with the care of the battery seldom are able to detect a short-circuit in a cell, and since this does not happen with a gelatine cell, the latter is preferable in spite of its lower capacity. If a vessel breaks or leaks, no sudden stoppage of the current occurs, but a gelatine cell will continue to work for some weeks longer, until the gelatine dries out. This is important since it makes the battery perfectly safe against accidents. The gelatine may be prepared more or less stiff according to the construction of the cell.

During the last four years the "Maschinenfabrik Oerlikon," in Switzerland, have made numerous applications of the gelatine cells. Tram-cars are run in several places, including Hildburghausen, Frankfort a. M., Rome, and Zurich. The standard car is equipped with a 15 h. p. motor operated at 220 volts and 59 amperes, shunt wound and with drum armature. By means of a special connection of the winding, this motor has a slow speed of 250 revolutions per minute; it is able to work with a maximum rate of 75 amperes, for half an hour to an hour; the weight is 2,450 pounds. The car is equipped with 120 gelatine cells, each of 150 ampere-hours capacity (in Butler hard rubber cases) weighing 44 pounds each, making a total weight of 5,500 pounds.

It may be interesting to know, that one set of batteries has been discharged and charged again 420 times without the capacity decreasing; the capacity was three-fourths of the original capacity at the 600th discharge and one-half at the 800th. Of course the car was subjected to all the incidents of tramway work; the portable plates were of the grid-type, which accounts for their being eaten up within a comparatively short time.

The same car with Tudor plates, is working now and will no doubt have double the life. The Tudor plates are 30 per cent. heavier than the grid-plates, if the capacity is compared at comparatively moderate discharging currents; but with high-discharging currents (the discharge being accomplished within ½ hour) the capacity of the Tudor plate is as high as that of grid-plates. Tudor plates for heavy discharges and portable batteries are not only durable, but allow the discharge of the whole capacity within an hour.

The question whether accumulator traction is practical or not depends solely on the durability of the cell, especially of the portable plates. If the record the Tudor plate will make in traction work is only half as good as that which it has made in the lighting field, accumulator-traction will pay.

STATIC CHARGES ON METALLIC TELEPHONE LINES.

BY

F. J. F. Schwartz.

It has been noticed nearly everywhere, I presume, that metallic circuits have become statically charged to some extent. This may be attributed in a measure to the proximity of other wires, but the escape of such charges has not generally, as far as I am aware, caused serious annoyance or damaged any apparatus; a click in the telephone alone being noticeable.

Since the building of several metallic lines which enter Montreal, disturbances of a static nature have attracted serious attention. These were first noticed during the winter of 1891, which was the first winter that the metallic lines were in use, and the duration of the disturbances has been from a few hours to several days, with varying intensity. The disturbances have occurred, thus far, only in cold weather, and generally about the time of a decided change. On several occasions snow was falling and the lines were found to be heavily charged, the charging rapidly becoming less as the weather moderated. At the time when the disturbance was first noticed, trouble was caused by the sparking from some of the drop coils to the iron cores whose supporting plates may have been grounded at the time. Shocks were occasionally received while inserting plugs into the jacks, but on listening on the lines they were usually found quiet.

When the lines are heavily charged, sparks are produced when a grounded wire is tapped on the metallic circuits, and loud clicks are heard when a telephone is included in the ground wire. On ordinary occasions subsequent taps would produce no sparks and only slight clicks until the lines had had time to recharge.

Arrester plates are in use in connection with the metallic circuits, and a frequent sparking takes place between the plates when the lines are heavily affected. In order to keep the lines in use and to prevent shocks, grounded retardation coils have been temporarily connected to the metallic circuits, and these have ordinarily served to rid the lines of the charge. A galvanometer or voltmeter placed in the grounded branch would indicate, after the first large throw, the passage of an occasionally reversing current. No unusual disturbances have been noticed on the single lines.

On April 3 and 15 the lines were heavily charged; several shocks were unexpectedly received and sparks could be easily produced. Snow began falling on each occasion, about the time the trouble was reported. The temperature on the latter date was from 31° to 37° F. Usually it has been colder when the lines have been affected. Within half an hour the disturbance was greatly reduced.

The only record that could be found of a similar charge, is a case reported by Mr. Preece, on the London and Paris telephone line, and which was traceable to induction from a thunder cloud. It would be interesting to know to what extent these disturbances have been noticed elsewhere.

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY.[1]—XIX.

BY

A. E. Kennelly

ELECTROMAGNETIC ENERGY.

MAGNETIC flux is a store of energy. It can only be brought into existence by work, and this work, embodied in the flux during its uniform continuance, is again released as the flux wanes and disappears.

If we first consider materials that are practically non-magnetic, so as to temporarily defer the introduction of iron into the subject, then the energy residing in the flux at any point where the intensity is B, amounts to $\frac{B^2}{8\pi}$ ergs per cubic centimetre. A flux density of B, therefore involves a pull along the direction of B, amounting to $\frac{B^2}{8\pi}$ dynes per sq. cm., a thrust all round, of $\frac{B^2}{8\pi}$ dynes perpendicularly outwards per sq. cm. of area, and a store of energy per unit volume to the extent of $\frac{B^2}{8\pi}$ ergs.

Thus the earth's total flux density in the open country near New York being about 0.6 C. G. S. line per sq. cm., the flux energy residing in earth, air, or other non-magnetic substance traversed by this flux, will be $\frac{0.6 \times 0.6}{8 \times 3.1416}$ $= 0.0143$ ergs. per c. c. and a cubic kilometre of this space will contain 1.43×10^{13} ergs. or 1.43 megajoules of energy in magnetic flux[2].

This equation $W = \frac{B^2}{8\pi}$ ergs. per c. c. is the fundamental relation of magnetic energy.

But there are other expressions for the energy in a magnetic circuit that are often independently useful, and merit consideration.

Apart from permanent magnets, and iron, cobalt, or nickel, which we still reserve for later examination, magnetic flux is only sustained in general by electricity in motion, that is to say, in particular and in practice, by electric currents; and its magnetic energy may be expressed in terms of the current strength and the flux enclosed thereby. If we suppose that an electric circuit in a single loop of any shape, is closed through a constant E. M. F. maintaining a steady current of c units, and that the total flux through the loop is F lines, the energy of the flux so far as it is dependent upon the current c and its local magnetic circuit, is $W = \frac{cF}{2}$ ergs, and this energy may be practically regarded as due to the linkage of F with c, although, strictly speaking, $\frac{cF}{2}$ only yields the integral of $\frac{B^2}{8\pi}$ taken throughout the space occupied by the loop's flux. This relation of energy to current flux is diagrammatically indicated in Fig. 38.

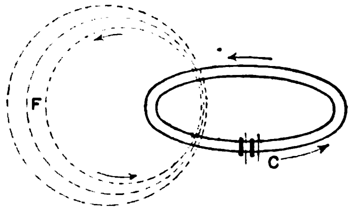

FIG. 38.—DIAGRAMMATIC REPRESENTATION OF SIMPLE MAGNETIC CIRCUIT LINKED WITH ONE TURN OF ACTIVE CONDUCTOR.

c = units of current. F = encircled flux. Energy, $W = \frac{cF}{2}$ ergs.

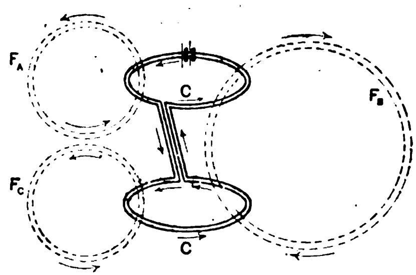

FIG. 39.—DIAGRAMMATIC ARRANGEMENT OF TWO LOOPS FORMING ONE COIL.

$F_1 = F_A + F_B$; $F_2 = F_C + F_B$; $W = \frac{c\,F_1}{2} + \frac{c\,F_2}{2}$.

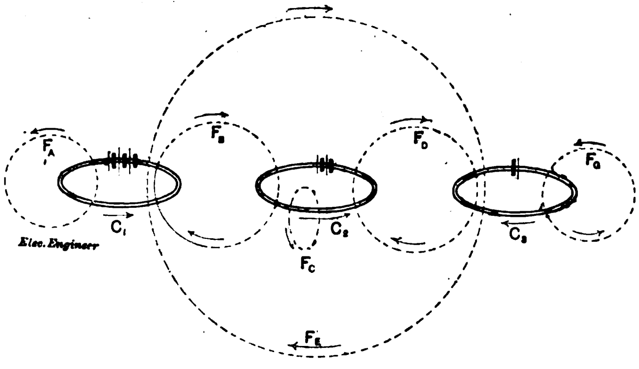

FIG. 40.—DIAGRAMMATIC ARRANGEMENT OF THREE INDEPENDENT CIRCUITS.

$F_1 = F_A + F_B + F_C$; $F_2 = F_C + F_D - F_E$; $F_3 = F_D + F_E - F_G$

$W = \frac{c_1\,F_1}{2} + \frac{c_2\,F_2}{2} + \frac{c_3\,F_3}{2}$

When the electric circuit forms more than one loop round the flux, as in a coil or solenoid, Fig. 39, or when several electric circuits are placed in propinquity, such as an assemblage of helices excited by independent batteries, Fig. 40, the same rule holds by extension. The total magnetic energy of the system is found by taking each loop in turn as though it existed alone; counting the total flux threading it in the positive direction F, and multiplying this by half the current c flowing steadily round the loop. The sum of all these products of $\frac{cF}{2}$ is the energy required, or

$$W = \frac{c_1 F_1}{2} + \frac{c_2 F_2}{2} + \ldots + \frac{c_n F_n}{2} = \tfrac{1}{2} \Sigma\, c\, F \text{ ergs.}$$

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[1] *Copyrighted* 1892, *by A. E. Kennelly.*

[2] 1 Joule = 10 millions of ergs. = 0.737 foot pound (at latitude of Greenwich).

This equation is therefore equivalent to the statement that $\frac{\Sigma c F}{2}$ is equal to the volume integral of $\frac{B^2}{8\pi}$ extended throughout the entire space occupied by the magnetic circuit or circuits considered.

We may take a few examples by way of illustration.

If a wire of copper 100 metres long, and one mm. in radius be bent into a circular loop, and a current of three units, or 30 amperes, flows steadily round this circle, we may take it for granted that the flux urged through this loop by the M. M. F. of the current when remote from iron, or other M. M. F.'s, will amount to 600,480 lines in all. The total magnetic energy will therefore be $\frac{3 \times 600{,}480}{2} =$ 900,720 ergs. = 0.9 megalerg. This energy will be absorbed by the flux from the source of voltage, during the establishment of the current, will remain conserved in the medium during the steady period of current flow, and will be restored to the circuit when the current ceases.

Next consider a closed circular solenoid of N turns (1,000) carrying a current of c (1.5) units, = 15 amperes, with a mean radius of revolution $r = 20$ cms., and a small cross-sectional area of $a = 2$ sq. cms.

We know that the total flux within the solenoid will be $\frac{2 N c a}{r} = \frac{2 \times 1000 \times 1.5 \times 2}{20} = 300$ lines, and this flux passes through each and all of the N turns, so that the summation of $\frac{c F}{2}$ is here reduced to simple multiplication and

$$W = \frac{N c F}{2} = \frac{1000 \times 1.5 \times 300}{2} = 225{,}000 \text{ ergs.}$$

Also the interior volume of this solenoid $V = 2 \pi r a = 251.3$ c. c. and within it, the intensity, assumed uniform, is $B = \frac{2 N c}{r} = 150$, so that the flux energy per cubic cm. of $\frac{B^2}{8\pi}$, amounts to $\frac{V B^2}{8\pi} = 2 \pi r a . \frac{4 N^2 c^2}{8 \pi r^2} = \frac{N^2 c^2 a}{r} = \frac{1000^2 \times 1.5 \times 1.5 \times 2}{20} = 225{,}000$ ergs,— the same result as above, proving in this simple instance the equivalence always existing between the total voluminal energy and the product of current turns by enclosed flux $\frac{\Sigma c F}{2}$.

If in this case, the turns of wire forming the solenoid had been irregular, either in size or in spacing, so that some flux had passed outside, thus causing the amount linked with each turn to be no longer uniform, it would have become necessary to make a strict summation in order to arrive at the correct amount of total energy, and

$$W = \frac{c}{2} (F_1 + F_2 + \cdots + F_n).$$

Again, since the flux is always proportional to the M. M. F. and consequently to the current strength, in the absence of iron, we may consider $F_1 = c f_1$, $F_2 = c f_2$, $F_n = c f_n$, where f_1, f_2, f_n, etc., are the fluxes that would respectively thread each loop if the current strength were unity— ten amperes—, and the expression for energy then becomes

$$W = \frac{c^2}{2} (f_1 + f_2 + \cdots + f_n) = \frac{c^2}{2} \Sigma f.$$

The quantity Σf which is the total number of lines linked with the circuit for unit current in the same, is called the inductance of the circuit, or sometimes the coefficient of self induction. In the closed circular solenoid just considered

$$\Sigma f = \frac{N F}{c} = \frac{2 N^2 a}{r} = \frac{2 \times 1{,}000 \times 1{,}000 \times 2}{20} = 200{,}000.$$

The practical unit of inductance is generally called the henry, and consists of 10^9 or one thousand million C. G. S. linkages, so that the inductance of this particular solenoid in practical units would be $\frac{200{,}000}{1{,}000{,}000{,}000} = 2 \times 10^{-4}$ or 0.2 millihenry.

For any given coil not containing magnetizable material, the inductance Σf is a constant depending merely on its geometrical conditions, and the energy stored up in its magnetic circuit evidently varies as the square of the current through the coil.

THE CROCKER-WHEELER MODEL FACTORY OPERATED WITHOUT SHAFTING.

SOCIAL reformers and more especially those who have devoted particular attention to the "labor question," have long since insisted upon the obligations of employers to furnish their workmen with abundant light and air and other conveniences which conduce to the comfort and the proper maintenance of health. This agitation has resulted in much improvement in the character of workshops within the last 25 years, and improvements in this direction are going on continually. But what was at one time done under compulsion is now in many cases being carried out voluntarily as a measure of actual economy. It stands to reason that a workman with plenty of air and light and with healthful surroundings generally will be able to produce more and better work than his fellowcraftsman housed in a dingy shop requiring the aid of artificial illumination at midday. The crowded conditions necessarily obtaining in a large city, have of necessity compelled those concerns desiring to afford their workmen the best opportunities, to seek out-of-town locations, where land is cheap and where plans for future extension and improvement can be carried out with ease. It was with these objects in view that the Crocker-Wheeler Electric Company recently removed their works from this city. After having twice increased their working facility to more than double the capacity, respectively, they became convinced that nothing short of an out-of-town location with unlimited room to spread out would meet the exigencies which they plainly foresee in the near future, and as a result they have acquired a splendid factory in a suburb of Newark, N. J., which they have appropriately named Ampere. The factory and its surroundings were illustrated in THE ELECTRICAL ENGINEER of April 19. Located on the line of the Delaware, Lackawanna & Western Railroad, within 20 minutes of the city, the new works occupy probably as convenient a location as could well have been found.

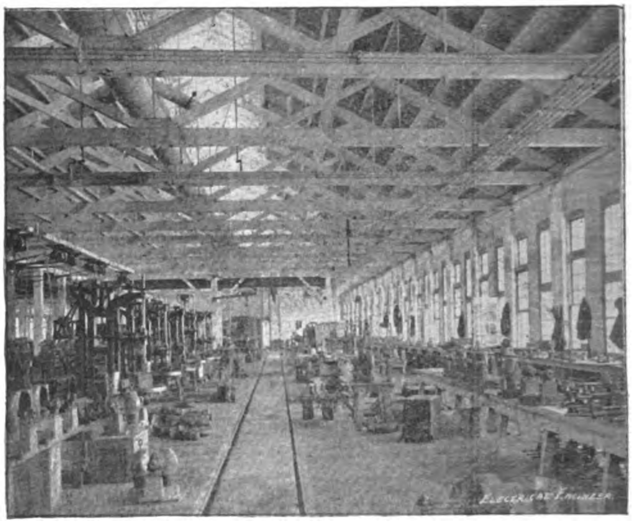

FIG. 1.—"COPPER SHAFTING," CROCKER-WHEELER SHOPS.

The works are situated in a plot of ground covering several acres, and embrace a large general shop, a winding shop, testing-room and tool-room. All these are one story buildings with monitor roofs, and thus afford abundance of light even on the darkest days. The general shop in which all the machine tools are located is 84 feet wide by 400 feet long, with floors of cement and brick. Arranged at right angles to this immense shop are the tool and the pattern-room; the testing-room, 52 x 160 feet; and the wiring-room, 70 x 145 feet. In addition to this there is another building covering a space of 80 x 120 feet, and various out-buildings including engine and boiler houses. The shipping facilities are of the most complete character; the works are situated directly beside the railway tracks, and two sidings run into the works so that goods can be delivered directly into the cars from the level of the shop floors.

We have already mentioned the fact that the Crocker-Wheeler Company has devoted particular attention to the equipment of machine tools with electric motors, in order to avoid the use of all belting and shafting and in a recent issue Dr. S. S. Wheeler gave a most interesting account of some of the work of this character already accomplished. In planning their new works the company have naturally sought to carry out this idea to its logical conclusion and the manner in which this has been accomplished can best be brought home by a view which we give of a section of the general machine shop, which is illustrated in Fig 1. Here the "shafting" consists of a line of half-inch bare copper rods 20 feet in length, mounted on insulators on the under side of a pine board which runs the whole length of the shop. The rods are joined together by sleeve couplings and soldered, the board carrying the copper rods being fixed to the roof beams.

Wherever it is desired to take off current, conductors are dropped directly to the machine underneath; and branches are run along the trusses to machines situated on the other side of the room. These branches are attached to the copper bars by means of special copper clamps, and the method of taking off a branch is shown in Fig 2.

The half-inch copper rods as above stated are bare and are held in position by a special porcelain insulator made by Messrs. Pass & Seymour of Syracuse, N. Y. It requires no tie wires. The bare circuits are run on the three wire plan, and all motors mounted directly on machines are provided with armatures designed for 220 volts. They are all provided with switches so that they can be connected either across one side at 110 volts, or across both, at 220; thus giving two speeds to the motor independent of the variable speeds obtainable by means of the cone pulleys.

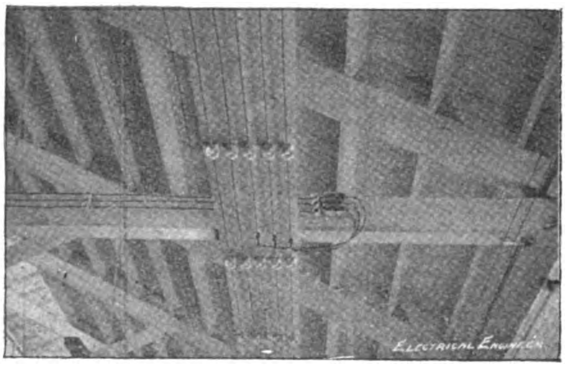

FIG. 2.—TAKING OFF A BRANCH.

The wiring arrangement adopted in the testing room, illustrated in Fig. 3, shows the great flexibility of the system to a marked degree. Here, it will be seen, the conductors coming from the various generators are run overhead and branches are taken off at various points which run down the side walls and are connected to a horizontal line of conductors situated under the benches. By this means the current can be tapped off at any point for testing the motors. The tap wires coming out from under the benches do not interfere with the workmen, and leave the bench free for the easy manipulation and shifting of the motors and machines under test.

The wide range of work carried out in the Crocker-Wheeler Company is well illustrated by the varied character of the power generating plant being installed. When complete, there will be available for testing and other purposes, two 30 h. p. 110-volt machines supplying current for the three-wire power distribution system; two machines of like power and voltage for testing purposes; one 500-volt machine for testing; one 110-volt machine for lighting; one machine with voltage variable between zero and 500 volts for testing purposes; one Thomson-Houston continuous current arc machine, and one alternator.

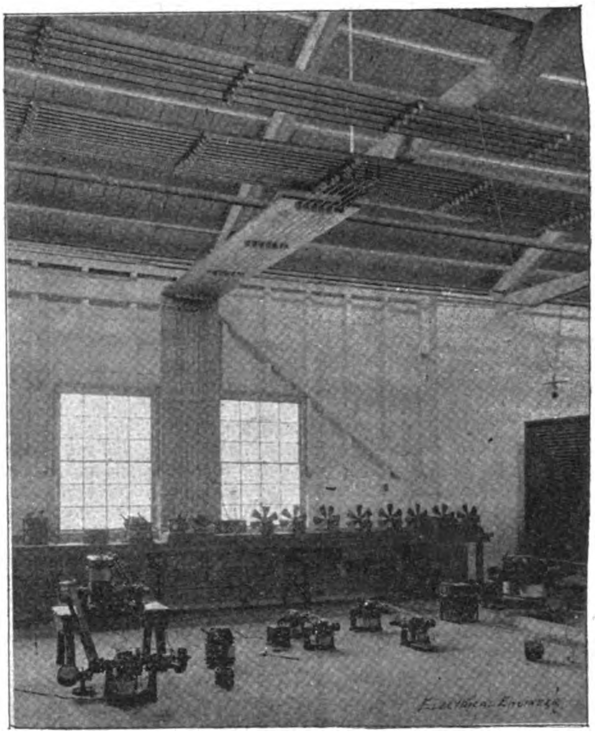

FIG. 3.—WIRING ARRANGEMENT, TESTING ROOM, AMPERE, N. J.

HALL'S PHENOMENON.

AT a recent meeting of the Berlin Physical Society, Prof. Kundt gave an account of some researches undertaken as an introduction to the study of Hall's phenomenon. As is well known, this is directly proportional to the intensity of the primary current, but inversely proportional to to the pressure of the plates; on the other hand, it is not strictly proportional to the magnetizing current in the case of the several metals so far examined, and it appeared probable that it might more possibly be proportional rather to the magnetization of the plate. Prof. Kundt wished to test this possibility in the case of iron, nickel, and cobalt, employing transparent metallic films of these metals magtized to 28,000 units, whose magnetization could be tested directly by means of their rotatory power. It was found that the Hall effect increased hand in hand with the increase of rotatory power, and therefore proportionally to the magnetization of the plates. The effect was, as Hall had already shown, positive in the case of iron and cobalt, negative in that of nickel. Bismuth deposited electrolytically in a transparent film gave very feeble or no results, whereas, when drawn out into a thin plate the effect was considerable.

NOTE ON ELECTRO-TANNING.[1]

BY DR. S. RIDEAL, F.I.C., F.C.S.

Mr. Falkenstein in his recent paper before the Institution of Electrical Engineers has brought forward fresh evidence on the influence of the electric current on tanning operations. His experiments are supplemental to those of previous investigators in this subject, and he shows that the functions of the electric current are twofold, being: (1) To increase the rate at which liquor diffuses itself through the hide by endosmose effects; and (2) to increase the chemical activity of the reaction by molecular vibration. Notwithstanding the apathy of tanners to embark capital in the new process, it is now an established fact that the joint action of electric current and agitation hastens the tanning process from 4 per cent. to 38 per cent. of the time taken when electricity and apparatus, or electricity alone, is not applied. Mr. Falkenstein has, however, contented himself with laboratory experiments, which, while throwing new light on the complex nature of the problem, are hardly so satisfactory from the industrial point of view as those of Mr. Trotter and myself, published in the *Journal of the Society of Chemical Industry* and in *Industries*, Vol. x., page 404, which were made on a large commercial scale. The most important point, however, brought out by Mr. Falkenstein appears to be that the passage of a current of 0.0086 ampere through a tanning solution brings about the conversion of a good deal of the tannic acid (about 10 per cent.) into an insoluble phlobaphene. This takes place at the cathode, and is due to the hydrogen there liberated removing from the "tannion" an equivalent of oxygen, leaving a tannic anhydride. This phlobaphene, however, is not wasted, as on heating it passes again into solution, re-forming tannic acid. The "bloom" which forms on the leather is therefore of value to the tanner, and should be removed, dissolved in hot water, and returned to the vat for economic working. In our experiments already alluded to the loss of tannin from the liquor was greater than that taken up by the hide, and made the process as then worked expensive in tannin material, but there seems no reason why the phlobaphene should not be recovered as suggested, and thus reduce the cost of the process considerably. The fact that sumac, and other tannins which yield much bloom, also give a greater precipitate when the electric current passes through their solutions, indicates that such tannins should be avoided in electrical work.

WIRING OF BUILDINGS FOR ELECTRIC LIGHTS.[2]

BY GEO. P. LOW.

It is almost universally the practice in drafting specifications for electric light wiring to stipulate that "the loss in potential in circuits shall not exceed two (2) per cent." or that "the wiring shall have not more than two (2) per cent. drop," meaning that the loss in volts on any conductor, due to the resistance encountered by reason of the current passing through that conductor, shall not exceed two per cent. of the voltage applied. Why two per cent. loss is so generally stipulated is not plain, neither is it always necessary that it should be specified in every case, as in some instances a loss of three, or four or even five per cent. would be more advantageous to the owner of a building, than would a loss of two per cent. Nevertheless, a two per cent. "drop" is generally specified, yet it is a fact that of all the larger buildings in San Fancisco, hardly one of them comes up to the two per cent. limit specified. When it is realized that 50 per cent. more copper is required to wire a building under two per cent. loss than under three per cent. loss, the importance of the matter becomes apparent. To place the facts in another light: a certain building is to be wired for incandescent lighting under specifications calling for two per cent. loss. To carry out these electric specifications would require the installation of, say, 3,000 pounds of copper wire. The electrician, however, realizing that the architect generally has no means of determining whether the specification has been adhered to in the matter of "drop" concludes to install the circuits at three per cent. loss. He does so and what occurs: The insurance inspector examines the installation and accepts it, for he only looks at the work from the fire underwriters' standpoint and his certificate only attests that the wiring presents no fire hazard. The central station people also examine the work and finding it to be safe and properly laid out, they too pass the work, for they do not compare it technically with the specifications any more than the insurance inspector does. The current is thrown on to the wiring, it works satisfactorily, all lamps burn to the satisfaction of the architect, nothing more is said about the two per cent. loss stipulation, the work is accepted and paid for and that is the end of it so far as 99 cases in 100 are concerned. Yet what has the wireman done: Instead of installing 3,000 pounds of copper wire, as called for under the two per cent. clause, and as he was paid for doing, he wired the building for three per cent. loss, and saved thereby 1,000 pounds of copper wire, for under three per cent. loss but 2,000 pounds was required, and no one was the wiser.

These frauds, so palpable to an expert electrician, yet concerning which laymen are utterly ignorant, are practiced daily by all save a very few first-class wiring companies and indeed many concerns ignore the loss requirement altogether in wiring, yet consider it in making up bids. Others will maintain that their work is figured for two per cent. loss, say, while upon questioning it soon becomes apparent that they do not know how to figure drop in potential, or they will use a two per cent. wiring table and will generally get a two per cent. loss each on mains, sub-mains and ultimate circuits, or six per cent. loss in all, while two per cent. was called for. A large concern having a capitalization of several hundred thousand dollars, when questioned as to the fulfilment of the two per cent. clause in a certain building it had wired, struck the keynote in the matter when it frankly and honorably admitted that it had not carried out the two per cent. requirement for the reason that it could not do so and compete for business. It had, however, placed the wiring in accorddance with "commercial usage" and it maintained that for that reason the work should be accepted.

The writer has frequently been asked to assign a reason why such discrepancy so frequently exists between the bids of different electrical concerns on the same piece of work. Reasons for this may be found from the facts above cited. Some few concerns will follow the specifications rigorously in every detail, while others, taking advantage of the almost universal ignorance prevailing in regard to electrical matters contract to do work that they never intend to perform. A dual result ensues: Owners pay for something they do not get—but they do not know it—and the electrical wiring business is utterly demoralized both physically and morally.

It must not be inferred that a two per cent. specification is never advisable or that a three per cent. clause will prove equally satisfactory as in the instance cited. To lay down a general law even for a given class of building is impossible and each building must receive specific consideration both in the matter of proper loss in potential as well as in the load basis upon which to figure the circuits. It is evident then that the drafting of electric wiring specifications is a matter worthy of most serious consideration and concerning which the architectural profession is deeply interested.

THE MOISSAN ELECTRIC FURNACE.

M. Henri Moissan makes some more interesting announcements in a recent number of the *Comptes Rendus* with regard to the latest results obtained by means of his electric furnace recently illustrated in these columns.

At ordinary temperatures the oxides of uranium are practically irreducible; but they have yielded to the heat of the electric furnace. M. Moissan prepares a mixture of uranic oxide ($U O_3$) and of the green oxide of uranium ($U_8 O$), adding a little powdered carbon, and strongly compressing the whole. Placed in M. Moissan's furnace, and exposed for a few minutes to a current of 450 amperes at 60 volts, one can obtain a metallic ingot, the pieces of which, if agitated, will emit sparks from the combustion of traces of foreign matter. The yield of uranium is fairly good, and from 200 to 220 grams may be obtained in 12 minutes; the average composition of the ingots being 90 per cent. uranium and 10 per cent. carbon. These carbides of uranium slowly decompose water at ordinary temperatures, and their melting point is much higher than that of platinum (1,780 degrees C.).

Chromium and manganese have also been prepared by M. Moissan. Pure protoxide of manganese is mixed with carbon, and exposed to 300 amperes at 60 volts, and in five or six minutes there is at the bottom of the crucible an ingot of carbide of manganese (89 per cent. manganese), weighing 100 to 120 grams. With less power smaller quantities can be obtained in a little longer time. If the reduction is effected in presence of an excess of oxide the percentage of carbon is greatly diminished, and in some samples it is possible to get 95 per cent. manganese. When the proportion of carbon is small the metal may be easily preserved in an open vessel; but as soon as the proportion of carbon increases the humidity of the air decomposes the substance.

A mixture of calcined sesquioxide of chromium and carbon is reduced in 8 to 10 minutes by a current of 350 amperes at 55 volts, leaving an ingot weighing 100 to 110 grams adhering to the crucible. The average composition of M. Moissan's samples was about 89 per cent. chromium, and the rest carbon. By a further attack in the furnace practically pure chromium may be obtained. Not only may the sesquioxide be reduced in this way, but also the natural chrome-iron ore $Fe O, Cr_2 O_3$.

ROPE-GEARING.

The experiences of a French engineer have convinced him that the cost of maintaining rope-gearing is three times that of belts. The weight of the ropes, moreover, is 2.64 times that of belts, while the loss in transmission is 5.77 per cent. with ropes and only 1.44 per cent. with belting.

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[1] *Industries.*

[2] *California Architect*, April 20, 1893.

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DROP THE TROLLEY IN THE SLOT.

ONE of the features of the rapid introduction and phenomenal success of the overhead trolley system has been a general assumption on the part of the public and the secular press that all electricians were blindly committed to the trolley, and were unfavorable to any other method of electrical transporation; with the corollary that the only thing needful to secure the universal adoption of the other methods was to overcome this professional prejudice. A letter addressed recently to a member of the ENGINEER'S editorial staff accused him roundly of being a besotted and partisan advocate of the trolley, but the writer of it has been unable to produce any evidence of his views or charges.

The fact is, broadly stated, that electricians are not wholly satisfied with the trolley, but have found it the best, and in reality the only practicable means of utilizing electricity, up to date. In the vast majority of places it has shown itself an enormous boon to the community and a source of economy to the management; and naturally its use has been urged with no little vigor. This state of affairs does not prevent electricians from seeing that various conditions, including an exaggerated popular objection, in most large cities, would render desirable the perfection of some further means of electric traction; and invention and capital have both been busy on new systems which would avoid the use of overhead wires. Up to the present time these efforts have been marked with dismal failure, and no amount of fine writing will disguise the fact. At least two or three million dollars have been spent in this country on abortive storage battery roads and conduit roads, and many able engineers have virtually spent their lives in the effort to attain success in these directions.

But this is no cause for discouragement. Our own faith in the ultimate success of other means than the trolley is stronger than ever, and we are glad to note that the magnitude of the prize still tempts adventurous capital. The later attempts have certainly gone nearer the goal than any that preceded them, and every month sees an advance. A few weeks ago we described some excellent storage battery car trips in this city. Last week, we described a very promising conduit road in Washington, and this week Mr. Shaw describes a conduit road he has just inspected at Hartford. Evidently there is abundant effort to drop the trolley in the conduit slot. Altogether, therefore, the time is near when the public, eager for rapid transit, but in dire fear of the "deadly trolley," will be able to get the full benefit of something better than it has hitherto enjoyed. But it must learn the patience that inventive and persevering electricians learned long ago.

HIGH RAILWAY SPEEDS.

THE obstacles which have been encountered in the attainment of very high continuous speeds on steam railways have given the electrical engineer much opportunity for speculation and calculation ; and experiments have not been lacking to show that electricity is eminently adapted to high speed work on railways. Nor have some able engineers hesitated to point out the limitations, not so much to the speed itself, as to the economy of operation under the conditions necessary to make high speed railroading safe. In this issue we print a description of the method to this purpose, proposed by Mr. Heilmann in France, and which will shortly be tested. While work of this nature is steadily progressing in the hands of electrical engineers, it is evidently exerting considerable influence in the field of steam locomotive engineering. One of the most recent evidences of this is to be found in the record claimed to have been made by locomotive No. 999, hauling the Empire State Express over the New York Central Railway. While this feat is entitled to cordial recognition, it must nevertheless be considered only as a tour de force. By this we do not in any sense wish to cast discredit on the laudable effort of the New York Central to afford its passengers the quickest possible transit, but a spurt at the rate of 112 miles an hour under exceptionally favorable conditions is not to be considered as the standard pace attainable on steam railways as at present equipped. The conditions for safe high speed travel involve many changes not only in locomotive and car design, but more especially in track construction, and the advantages possessed by the electric over the steam locomotive are so pronounced, that the performance just mentioned ought to act as an encouragement and not as a disheartener to electrical engineers. The high speed electric railway work actually under way will, it is hoped, serve to demonstrate these advantages beyond dispute.

Users Free from Molestation.

THE decision rendered by Judge Coxe last week in the suit of the Edison Electric Light Co. against the Equitable Life Assurance Co., of New York, given in full in our issue this week—is of paramount importance, as it goes to the very bottom of a question which has been the subject of much anxious discussion. The suit was one brought by the owners of the patents against a private user, to recover damages for the infringement and use of certain electric light fixtures. Judge Coxe, however, now decides that by the plaintiffs' acquiescence in the alleged infringement for 11 years they have forfeited their rights to recover. The bearing which this decision will have on the suits to recover from private users of incandescent lamps is not difficult to foresee.

ELECTRIC RAILWAY DEPARTMENT.

THE MUNSIE-COLES SURFACE CONTACT ELECTRIC RAILWAY SYSTEM.

BY

A. C. Shaw.

THOUGH to the overhead trolley may be attributed the vast and rapid expansion of the electric railways of to-day, there are many cities which still object to allowing the street railway companies to erect the overhead system, claiming that it is not only unsightly but dangerous. This fact is well-known to electrical engineers, and many attempts have been made to eliminate the trolley and use an underground conductor of some kind. Unfortunately most of the experiments were made before the time was actually ripe, and too little attention was paid to the details and the thorough insulation of the conductors. There are many who still believe, however, that some surface system will still be adopted, and we have already illustrated various systems of this style. This week we illustrate the Munsie-Coles system which is practically an underground system, in so far as the conductors are all buried, but which in practice depends upon a surface contact, and which presents many features absolutely new and distinctly its own. A section of road, laid down on the Munsie-Coles system, has been in practical operation in Hartford, Conn., for the past four months, meeting with the most severe winter experiences, and has shown itself to be a practical success and capable of performing all that the inventors claim for it.

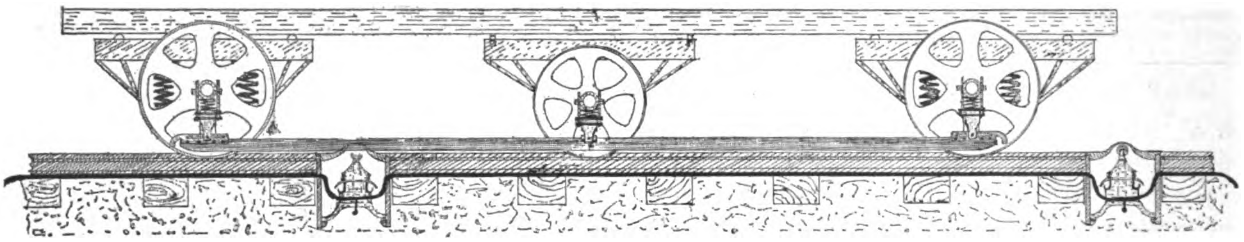


FIG. 1.—THE MUNSIE-COLES SURFACE CONTACT ELECTRIC RAILWAY SYSTEM.

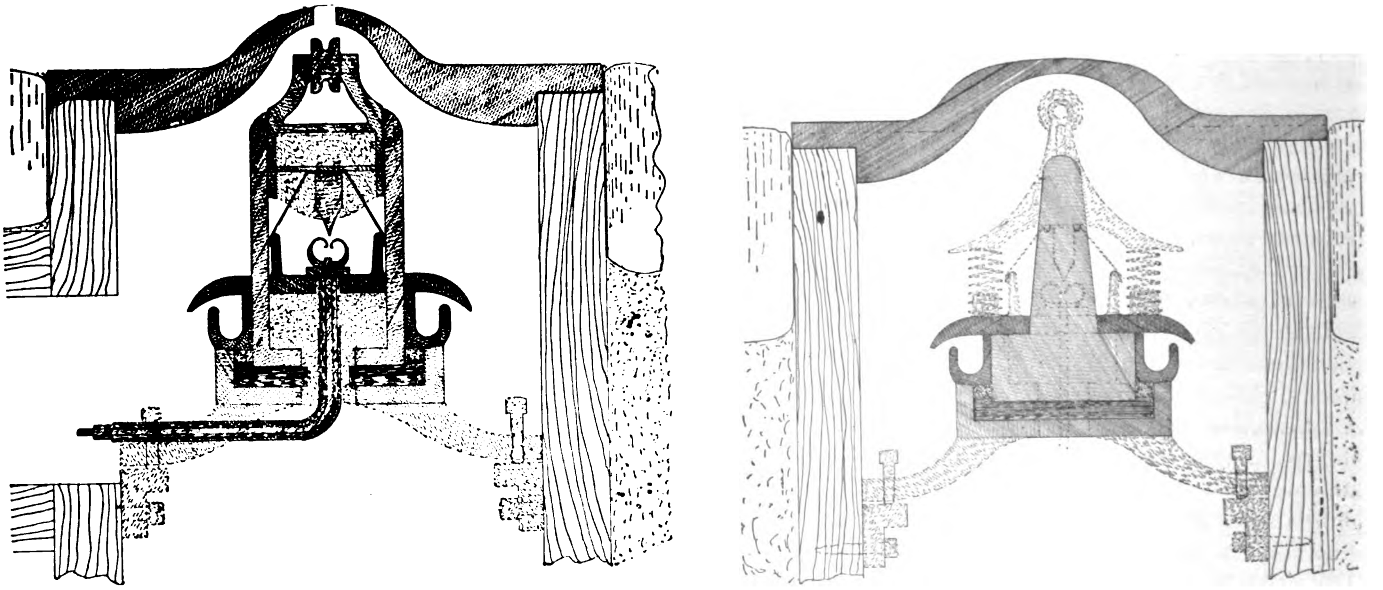


FIG. 2.—THE MUNSIE-COLES SURFACE CONTACT ELECTRIC RAILWAY SYSTEM.

The system, broadly, consists of a thoroughly insulated conductor running underneath the ground (a lead covered cable if desired can be used with perfect success), which at intervals of about 16 feet is tapped into underground boxes, laid between the rails, and between two ties. Each box contains an insulator on which rest the metal contact points, which supply current to the car when over that particular box.

The general arrangement is clearly shown in Fig. 1, in which a car is shown in contact with two boxes. Under the car is attached a thin metal ribbon, which makes the contact between the underground conductor and the car motor. The contact box may be of wood or iron; in it, resting upon four cast iron legs, is the insulator, carrying the contact points, and also the little metal wheel which comes in contact with the metal strip on the car, but which is not in circuit, until depressed on to the contact points by the metal strip. Figs. 2 and 3 show more in detail the construction of the insulator in the box. On the cast iron supporting stand and insulated from it by hard rubber or other material, is a metal frame in which slides another frame carrying the contact wheel. Around the first frame is a porcelain cup and petticoat, attached to which on the inside are metal springs, in solid contact with the conducting cable, and which contains on the outside a quantity of sulphuric acid to absorb any moisture which may get into the box.

When the car comes over the box, the metal ribbon depresses the wheel and its supporting frame until the contact point bears upon the spring clips and makes circuit. There is no sparking at the wheels as the ribbon is long enough to be in circuit with the succeeding box before leaving the first, and there is no sparking at the contact points as the wheel is out of circuit before the contact is broken.

In order to prevent the metal ribbon from grounding on the iron cover the ribbon is protected at both ends by two metal shoes, which are insulated from the ribbon but which guide it into position. In addition, the cover is made of two parts the inner portion of which is itself insulated from the ground by the insulated supports on which it rests; so that, even should the ribbon touch it at any time, it would not be grounded and consequently would not spark or waste current.

One of the strongest claims that is made for this system is its perfect insulation. The conductor which practically takes the place of the trolley wire, is continuous and is insulated throughout, and may be of any known highly-insulated cable. It is exposed only at boxes, where it is tapped on to the spring clips. There can, however, be no leakage here, as these clips are thoroughly insulated from the ground by the best of materials and workmanship. It must be borne in mind also that the little wheels, the only part of the system visible to the eye, and actually exposed, are not in circuit except when the car is directly over them, so that there can be no leakage from them, and they are perfectly harmless to the touch; for, just as soon as the car passes, the springs beneath them lift them out of contact, and they are perfectly dead until the next car comes along.

Very little excavating is required for the installation of the system, a narrow ditch being all that is required for the reception of the cable, which may be laid on the top of the ties, and a small hole every 16 feet for the reception of the box which contains the insulator. The work of installation can thus be very rapid, the insulators being all prepared in advance, and put in position in very short time, after the cable is laid and the boxes have been put in position. The system can be installed, at an expense, outside of the expense of the cable, of from $6,000 to $7,500 per mile, according to the nature of the work to be done, while for light suburban work $5,000 per mile would most probably be ample.

The system is being introduced by the Munsie-Coles Electric Railway Equipment Company, of 16 and 18 Exchange place, New York city.

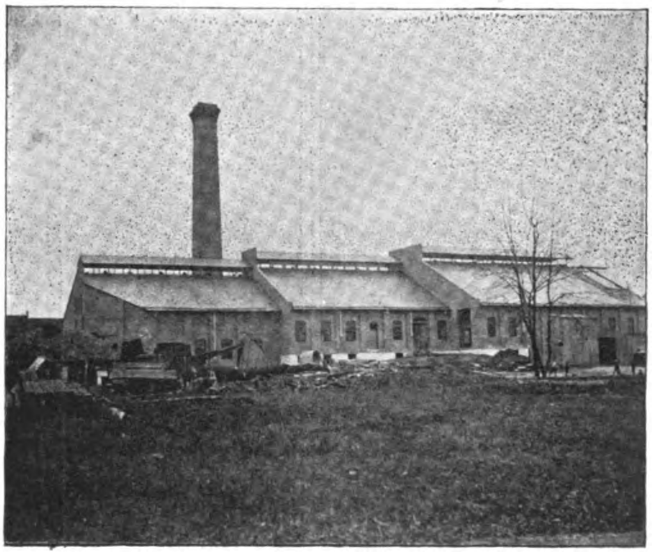
THE UNION RAILWAY AND CHESTER & MEDIA ELECTRIC RAILWAY, CHESTER, PA.

THE UNION RAILWAY COMPANY, of Chester, Pa., owns all of the street railway lines in the City of Chester—some 15 miles of single track—and in addition it leases the Chester & Media Electric Railway Company, having a line of about 7 miles of single track from Chester to Media, the latter being the county seat of Delaware county. The company is continually increasing its mileage for the purpose of connecting the outskirts of the two places with the business centres, and since the original plans were drawn has doubled its power-house and car equipments, thus being able to provide comfortable, rapid and frequent service throughout the towns and a service between them that is of great benefit to both communities and the intermediate suburban population.

In the winter of 1892, Col. Samuel A. Dyer, president of the company and of the Chester National Bank, who also controlled the majority of the stock of both corporations, determined to change his horse system to the overhead trolley. He at first thought that the problems to be solved were those that the layman and horse-railroad man could easily handle, and acting with this idea, approved by some of his associates, the company contracted for their steam plant, electric generators, motor equipments and cars, but the president soon found that the purchase of such apparatus was not the only thing to be considered in designing and building a system of electric railway. In fact he then realized the importance of what is so aptly put by that eminent engineer, Gisbert Kapp, C. E.:—"Some years ago the first requirement of an electric company who aspired to get the confidence of the public was to have a special 'system.' This magic word was the key to commercial success—for a time. Now we have grown wiser. We know that practical success does not so much depend on the *system* as on the *men* who plan and carry out electrical work; and the less of a special system and more of general good engineering there is, the better." In realizing the importance of good engineering, Col. Dyer retained such services to complete the design and execution of the work. It was a serious handicap to the engineer to find apparatus purchased at the time of his taking charge, and the results finally obtained are not in all respects what the latest and best practice can give; but the plant is a serviceable one with nothing for show sake only.

The illustration herewith shows the building for power house, car shed, etc.—a fine structure when completed, being 250 feet long by 100 feet wide. The car shed has room for thirty 16-foot cars with pits under the entire floor and room for workshop, etc., on the same level as these pits. The engine room has space for four Corliss engines, countershafting and four generators. The original plant consisted of one 150 h. p., and one 225 h. p. Wetherill-Corliss condensing engines, with attached jet condensers, two Short railway generators of same capacity as engines with the countershafting so arranged with clutches that either engine could drive either generator or both of them by working above their normal capacity. This plant has since been increased to double its capacity with engines of the same type and make and Westinghouse generators. The boiler room has space for eight 125 h. p. return tubular boilers, four of which were originally provided by Robert Wetherill & Co.; these were so arranged that they occupied two sides of a square when all eight were in position with the brick stack, 125 feet high, in the corner thus made, around which were placed the pumps, etc. The building is located on Chester Creek. The car shed rests on a rock foundation; so does the engine room except the corner next to the stack which is carried on crib work for about 10 feet of the east wall, subsequently reinforced by a pier of stone some 25 feet deep built at this corner from a rock foundation upon which the stack rests with foundations of the same depth. Within 10 feet outside of the stack a 40 foot pile did not strike rock, and the entire boiler house, boilers, etc., rest on piling. As peculiar conditions of ground existed, great care was taken in all the foundation work, with the very best of results and minimum settling.

The cars were built by the J. G. Brill Company and the Lamokin Car Works while the Short and Westinghouse Companies furnished the motor equipments. The original number of cars was 14, now increased to about 30, the Media cars being vestibuled and having double 30 h. p. equipments owing to heavy grades, the others being open platforms and double 20 h. p. equipments with some two or three single 20 h. p., only run on certain lines where no grades exceeding two per cent. exist. Brill No. 13 trucks are used throughout. The overhead line is of the latest type of construction with octagonal wooden poles, ratchets, cable-span wire, and Thomson-Houston hard-rubber line material, and was erected by the Woodbridge and Turner Engineering Company. The track of the Media line was laid on 6 x 8 x 7½ inch yellow-pine ties, furnished by Black & Son of Chester, with 65-pound girder rails rolled by the Tide Water Mills of Chester, Pa., in Media and along Providence avenue, while across the fields 50-pound Pennsylvania Steel Company's T-rail was used. The Media division was ballasted its entire length with broken stone. The new track in Chester was laid by Messrs. Field & Hogan for the Lewis and Fowler Girder Rail Company, who furnish all the iron track material consisting of their 63-pound box rail, chair joints, etc., of the heaviest and latest pattern. Reed & McKibbin did the electric track bonding as per plans of the engineer as well as the laying of track on the Media division. There were several bridges and trestles to build and one to strengthen. There were many vexations, delays and annoyances in the prosecution of the work due to interference of the local authorities and their lack of protection to the company from interferences of the property owners along the line. This, together with "too many cooks to spoil the broth," in the company itself, prevented the road being placed in operation until winter had fairly set in again. Much credit is due the various contractors in the character of their work and the care displayed in carrying out the plans and specifications of the chief engineer, Charles H. Davis, who was represented on the ground by Edward A. Colby and Charles H. Warner as resident engineers.

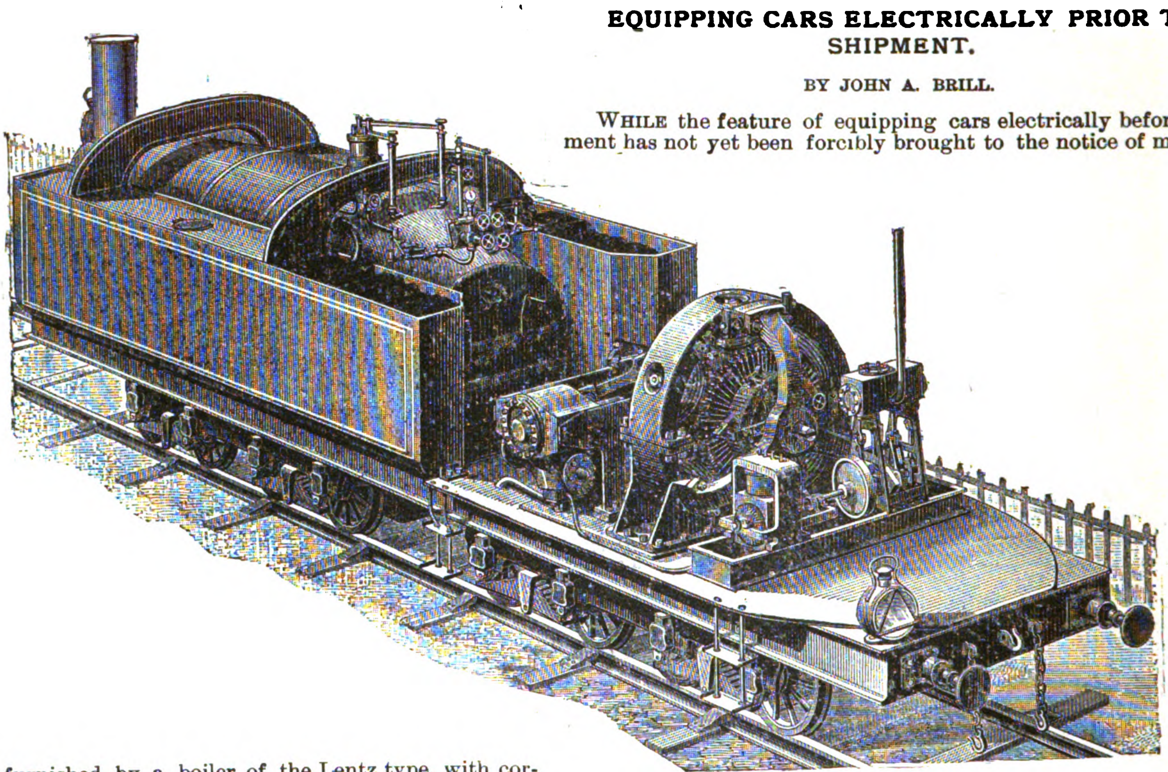


POWER HOUSE, UNION RAILWAY, CHESTER, PA.

A STATE LAW passed last month compels all electric or cable roads in the State of Ohio to protect their motormen and gripmen from the weather by screens. No mention is made of the horse or mule cars.

THE HEILMANN ELECTRIC LOCOMOTIVE.

AMONG those who have devoted particular attention to the problem of high speed electric traction is Mr. Heilmann of Paris, who has already brought forward a number of projects looking towards the substitution of electric for steam locomotives. His first proposition was offered as an intermediate solution of the propelling power problem on railroads, one which will admit of utilizing electric traction without necessitating any change whatever in the ordinary roadbed and track system. This he designed to accomplish by fitting up each car of a train with electric motors and by supplying the necessary current from a special car at the head of the train, this car also being self-propelling electrically and carrying a steam boiler, engine and electric generator outfit. Subsequently Mr. Heilmann designed such a car as an electric locomotive, pure and simple, to develop about 500 h. p. in motors fitted on its axles, supplied with current from the generators carried on the car itself and intended to haul trains after the manner of an ordinary steam locomotive. An illustration of one of these electric locomotives, now being built at the works of the Société des Forges et Chantiers de la Méditerrané, at Havre, France, is reproduced herewith from the *Revue Industrielle*, and shows the more prominent features of the whole arrangement.



HEILMANN ELECTRIC LOCOMOTIVE.

Steam is furnished by a boiler of the Lentz type, with corrugated furnace and combustion chamber, coal bunkers and water tanks being arranged at both sides of the boiler. The latter is placed at the rear of the locomotive, the chimney also being at the rear, with the furnace doors toward the front end.

Directly in front of the boiler, with due allowance for firing room, is a horizontal, nominally 500-h. p. steam engine, placed transversely. It is compound, the high and low pressure cylinders being placed opposite each other, with pistons working 180 deg. apart. Special attention has been given to the balancing of all the moving parts of this engine. The valves, which are of the piston type, are placed underneath the cylinders.

The engine is coupled directly to the generator shaft, the generator being a continuous-current dynamo furnished with a separate exciter. The latter is worked by a small vertical steam engine as shown in the cut. The generator will furnish a current of 1,025 amperes and 400 volts, and is a six-pole machine. The exciter is of the four-pole type, rated at 20 h. p., and besides furnishing the exciting current is to serve also the purpose of lighting the train. The electric motors mounted on the driving axles also are of the four-pole type.

The weight of the whole locomotive, completely equipped, is placed at about 100 tons. When completed the engine is to be subjected to prolonged and careful trials on the French state railroads.

PIQUA, O.—The Ansonia Electric Company of Chicago has secured the contract for the overhead equipment for ten miles of road for the Miami Valley Railway running from Piqua to Troy, O.

THE ORIGIN OF "TRAMWAY."

BY C. TENNANT LEE.

A RECENT legal decision in Canada upon the subject of duty on iron rails involved the question of their use whether for "railways" or for "tramways." Connecticut state legislation has also distinguished between electric railways and tramways.

It is only of late that this word "tramway" has been used to any extent in this country; but in England, where the term originates, it has been the common word, in its abbreviation "tram," for "horse railroad," and later, "street railway."

In the life of George Stephenson, by Samuel Smiles (London, 1857), it is stated that "as early as 1602 wooden rails were used between the coal-pit near Newcastle and the river, so that a large loaded wagon could be drawn by one horse" (p. 57), and also that "in 1800 Mr. Benjamin Outram of Little Eton in Derbyshire, used stone props instead of timber for supporting the ends and joints of the rails. As this plan was pretty generally adopted, the roads became known as 'Outram roads,' and subsequently for brevity's sake 'tram roads,'" (P. 59). "Tram-road" later was changed in England to "tramway," and in this form has reached us.

EQUIPPING CARS ELECTRICALLY PRIOR TO SHIPMENT.

BY JOHN A. BRILL.

WHILE the feature of equipping cars electrically before shipment has not yet been forcibly brought to the notice of many of the officers of electric railways, it is undoubtedly gaining weight every day and gradually coming into favor. Companies who have bought car bodies from one factory, trucks from another and electrical equipment from another, and who have attempted to assemble the parts, mounting the motors, wiring and equipping the cars, are in position to appreciate the force of an argument that it is money saved to the street railroad company to have this work done before shipment. The car works of the J. G. Brill Company at Philadelphia is the only factory in the country where this requirement can be fully complied with.

The electric companies have regular forces of men stationed at their works whose only duty it is to wire cars and mount motors. In addition to these forces already mentioned, the Brill Company has a competent foreman of electrical department and several men who do the work of wiring and equipping electrically the cars when contracts call for this work to be done by the car builder.

The Newark Passenger Railway Company, of Newark, N. J., and many other parties for whom the Brill Company have done this work can testify to the great advadtage of this. The Newark Company lately received a lot of 20 cars from the Brill Works and got them in active operation within one hour after the cars were unloaded from the freight cars. All cars and trucks built by the Brill Company and equipped electrically either by their force of workmen, or by the workmen of any of the several electrical manufacturing companies are tested before shipment on Brill's electric railway, which is about one-third of a mile long, including sharp curves and heavy grades insuring accuracy in the electrical work, as well as certainty of operation when the cars reach destination. In a number of cases cars from the Brill Company have been taken from the railroad station to the car barns by their own power after having been unloaded from the freight cars. This matter is well worth the consideration of any company intending to purchase cars and trucks.

ELECTRIC ELEVATED ROAD IN BALTIMORE.

THE following dispatch from Baltimore, Md., refers to the road described recently in THE ELECTRICAL ENGINEER by Mr. Abbott, its engineer: The first elevated railroad ever built south of New York is about completed in Baltimore, and will go into full operation next week. The line will be operated by electricity. From the centre of the city to near the northern limit the road has been built like the New York elevated roads. Just before reaching the city limits the road strikes the level of the streets and continues as a surface road for seven miles into the country, with a full double track over the entire route. This electric road has been built at a cost of about $1,500,000 by the Jarvis & Conklin Mortgage and Trust Company of London and New York. In connection with this enterprise English capitalists have invested nearly $1,000,000 in the purchase and development of an eight-hundred acre tract of land adjacent to the city.

YOUNG HOPEFUL AND THE TROLLEY.

THERE is one boy living near Grove Hall who, I venture to say, writes a Boston reporter, would not be at a loss to do the best thing possible under the most trying conditions. If anybody stands a chance of coming out of some horrible fire unscathed, he is the boy. He is about ten years old, and a very bad boy, but he has presence of mind to spare. He was standing on the rear end fender of an electric Grove Hall car day before yesterday, and the car suddenly darted ahead very rapidly. He saw the conductor coming. The car was going too fast to risk jumping off, so what should this young hopeful do but reach up over the rear dasher and pull the trolley from the wire. This, of course, attracted the conductor's attention at once, and he rang the bell to stop. The boy then coolly stepped off, and in going away remarked, "Ta-ta!" to the conductor, who took the matter philosophically.

ELECTRICAL WORK AT CANTON, O.

THE CANTON-MASSILLON ELECTRIC RAILWAY COMPANY, will commence work on their extension to Navarre, the latter part of July. They have just placed another new coach, the "Stark," on their line between Canton and Massillon, and will have their new coach "Perry," on in a couple of weeks.

WORLD'S FAIR DEPARTMENT.

THE TEMPLE OF TELEPHONY.

ONE of the most striking exhibits in the Electricity Building is that made by the American Bell Telephone Company, who have erected a beautiful pavilion covered with "staff" like the Fair buildings proper. It stands at the southern end of Electricity Building, near the entrance, and occupies a floor space about 70 by 90 feet in the transept. It is a Grecian temple with domes and a Corinthian portico, and stands about 20 feet high. It has a central dome rising to a height of 45 feet. It is stated that the interior court under the dome will be devoted to long distance concerts, while the space around the exterior of the court will be occupied by offices, telephone booths, exchange boards, models of apparatus, portraits, relics, etc. We reproduce here from *Frank Leslie's Weekly*, a clever little sketch of the temple by Mr. E. J. Meeker. The material with which the outer walls are faced gives an air of solidity to the whole structure. The temple will undoubtedly prove one of the greatest attractions of Electricity Building, and even of the Fair as a whole, and the exhibit is a very creditable manifestation of public spirit on the part of the Bell telephone authorities.

BELL TELEPHONE TEMPLE, ELECTRICITY BUILDING.

J. H. BUNNELL & CO. AT THE WORLD'S FAIR.

AMONG the few exhibits which were ready for the opening day of the World's Columbian Exposition, was that of Messrs. J. H. Bunnell & Company, of this city. Part of their work is exposed in the Navy Department Exhibit and attracted much attention on the part of over 8,000 persons who visited the Naval Observatory on that day.

THE GENERAL ELECTRIC MODEL ARC PLANT.

THE model arc light plant and exhibit of the General Electric Company, of which brief mention was made in THE ELECTRICAL ENGINEER of May 3, occupies the southeast corner of their space, and, as will be seen by reference to the accompanying engraving and plan, is designed to show, in actual operation, all the standard types of arc generators and lamps made by the company.

Near the main aisle is a pit about 16 feet square and eight deep, in which stands a 220 volt, 150 kilowatt Edison motor, the shaft of which is connected by a friction coupling to the line shaft extending beneath the floor all the way across the space, and running at about 400 revolutions per minute. To this shaft are belted nine arc dynamos, one of each standard size of Thomson-Houston make and one 100-light Excelsior. These not only serve as an exhibit, but furnish current to 105 lamps of 2,000 c. p. each, which are wired up for service lighting in the building, besides others for individual exhibitors. The model plant space itself is lighted by four 1,200 c. p. Thomson-Houston and six 2,000 c. p. Excelsior lamps, while at each corner of a square enclosing the circular space occupied by the central tower of light is a 4,000 c. p. lamp suspended from the gracefully curved top of an ornamental pole. The chief of these four poles is 38 feet high and was made by the General Electric International Company and brought to this country for the Exposition. It contains a continuous steel shell extending from top to bottom to give it the necessary strength and around which is built up the artistic iron work. The diameter at the top is by this means reduced to only four inches and the design of the whole is light and graceful. The pole with the lamp in position looks like a great, luminous lily, the stem bending with the weight of the flower. A counterweight for the

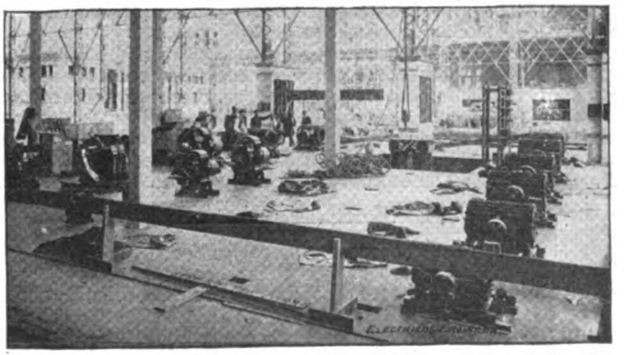
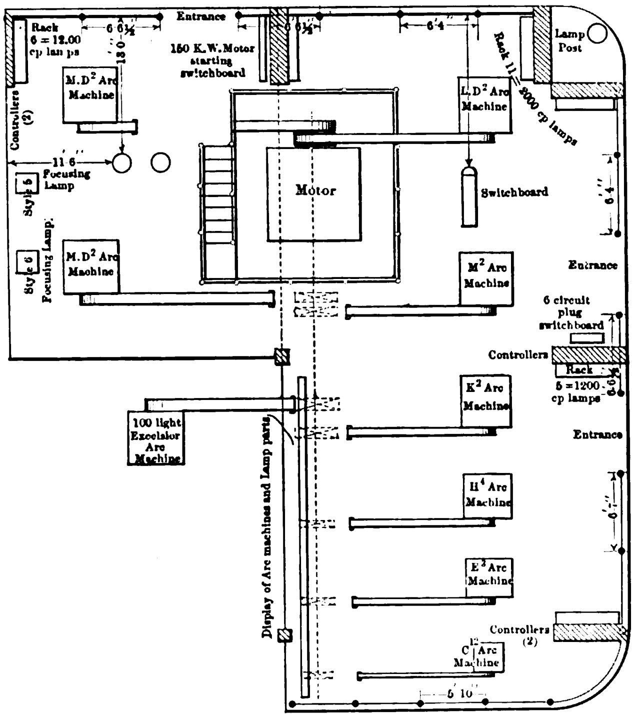


FIG. 2.—GENERAL ELECTRIC TYPICAL ARC STATION, ELECTRICITY BUILDING.

lamp is contained within the shell, and at the base of the pole is the ordinary Thomson-Houston switchboard. There are, besides, 42 arc lamps on Walworth poles surrounding the spaces occupied by the General Electric Company, which form each of the four angles made by the intersection of the nave and transept; and illuminating the whole centre of the building, suspended from brackets, are six constant potential arc lamps on the three-wire system.

The switchboard from which all these circuits are controlled is a six-circuit plug-board 39 inches wide and nine feet high, with ammeter and lightning arrester sections, all of slate. Just now it presents a rather gruesome appearance owing to a large sign on which is painted a death's head and the word "Danger." This is, however, merely a little device of the engineer in charge to prevent the public from pulling out the plugs and trying to look through the holes. It is a way they have here just now.



Elec. Engineer

FIG. 1.—GENERAL ELECTRIC TYPICAL ARC STATION, ELECTRICITY BUILDING.

In addition to the generators and lamps described, there are shown here four Excelsior arc motors of ten, five, three and one horse-power, respectively, all running; a plating machine wound for 20 volts and 2,400 amperes, a 200-light incandescent dynamo, and 110-volt motors of ten, five, three and one horse-power. Fan motors of $\frac{1}{8}$ and $\frac{1}{4}$ h. p. for desk and ceiling are also shown, while about the space are hung on racks, 16 Excelsior and 22 Thomson-Houston lamps of special finish, showing all the different styles of the company's make.

A 6,000 c. p. projector and a 5,000 c. p. locomotive head-light occupy a corner by themselves.

The latticed iron columns supporting the roof of the building have been boxed in, and on these are arranged all the separate parts of the Thomson-Houston lamps, regulators, blowers, commutators, etc., and these are supplemented by two show-boards, one 18 by 22 feet, completely covered with different styles, shapes and sizes of carbons, and the other, 18 by 26 feet, showing various arc apparatus. The exhibit is in charge of Mr. D. L. Benson.

WORLD'S FAIR NOTES.

THE electrical part of the Exposition was fully brought into play on the night of May 13, when the spectacular effects were all employed, while various buildings were outlined with incandescent lamps. The effect was very pleasing to the thousands who assembled on the grounds.

The Fair again remained closed on Sunday, and it looks as though a big fight will be necessary to open any portion of it.

Chief J. P. Barrett has issued a notice that work in Electricity Building must cease May 13. He disclaims any further responsibility for tardiness. It is believed that work will not be finished before July.

BROWN & SHARPE MANUFACTURING COMPANY AT THE FAIR.

As a guide to the Fair and their exhibit, as well as a manual of travel, Brown & Sharpe Mfg. Co. have issued a beautiful little pamphlet which describes the growth of their business, and its present status. This is accompanied by a variety of information about Providence, R. I., means and cost of travel, consuls in Chicago, a brief cable code, a bird's-eye view of the Fair, and much other useful data. A few details are given with regard to the exhibit of the company in Machinery Hall, including 40 machines and 1,500 small tools. The pamphlet is richly, though simply printed, and is ornamented with a number of quaintly archaic cuts.

EUREKA TEMPERED COPPER AT THE FAIR.

THE EUREKA TEMPERED COPPER Co. has prepared for distribution at the Fair a very pretty little souvenir, with cover stamped in copper lettering. The brochure gives a quantity of information on the subject of tempered copper and its uses, with reports of tests, and closes with a large collection of strong testimonials as to the remarkable merits of the material. On the back cover is a print of the John Scott medal of 1891, awarded by the city of Philadelphia, through the Franklin Institute.

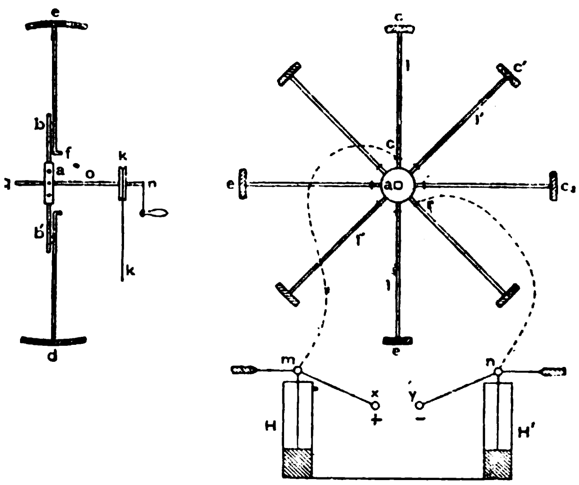
MISCELLANEOUS.

A COLLECTOR OF ATMOSPHERIC ELECTRICITY.[1]

BY L. PALMIERI.

THE apparatus is based on the principle that as a conductor is raised in the open air it collects positive electricity (in ordinary weather), and that then, after discharge, it collects negative electricity as it descends. Since 1850, the date at which I undertook the study of these phenomena conjointly with those of the ascending and descending liquid vein and others, again, which I called phenomena of approach and recession, I conceived the idea of constructing a rotary electrical machine which became a source of electricity on fine, calm days. I made an entirely rough piece of apparatus, which is shown in several editions of my "Leçons de Physique," but it was always my intention to give it a convenient form and to add a suitable condenser. It is this rough piece of apparatus which is shown diagramatically in the accompanying illustrations.

Let *a* (Figs. 1 and 2) be a modern disc, upon the circumference of which are fixed eight insulated rods *b b'* (Fig. 1). These rods carry an equal number of conductors *l l'*, terminated at the top by narrow strips *c c'* of any convenient length; at the bottom the rods are terminated by little elbows *f*. Both wheel and spokes can be made to revolve rapidly round the axle *q n o* (Fig. 1), either by means of a handle or an endless cord *k*. A spring or strip of metal touches the projection *f* of each spoke as it reaches a vertical position, and a second one presses against the spokes as they come to the diametrically opposite position, so that positive electricity is collected at *c* and negative at *r*. At *H* and *H'* are placed two Leyden jars similar to those used in the Toepler and Holtz influence machines, *x* being the + terminal and *y* the — terminal of the machine.



FIGS. 1 AND 2.—PALMIERI'S COLLECTOR OF ATMOSPHERIC ELECTRICITY.

Such is the collector in all its simplicity. In this note I only wished to describe its principle, and will say something at another time about the effects it enables one to obtain.

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[1] *La Lumière Électrique.*

THE TELECTROSCOPE.[1]

BY LEON LE PONTOIS.

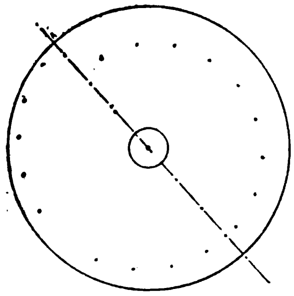

Fig. 1.

I DESIGNATE by this name an apparatus having for its object the transmission of pictures or views of moving or stationary objects at great distances, and as I use electricity for the purpose of obtaining this result, I call this apparatus a Telectroscope. I intend to describe to you to-night the general outline of an apparatus that I have conceived for the purpose of seeing over as great distances as we hear by the long distance telephone.

It is a well-known fact that the impressions made on the retina by the rays of light emitted or reflected by a body do not disappear instantaneously if an opaque body is suddenly placed between the eyes and the luminous body. On account of the same principle of inertia, the impressions do not take place on the retina as soon as the light rays strike it. It takes a certain time before the optical nerves vibrate synchronously with the rays of light. That is why we cannot see a body when it passes very rapidly before our eyes, and we have in optics the retardation of vision as we have in electricity the capacity and the self-induction. I have spoken about the persistence of vision because the telectroscope is partially based on this fact.

The transmitting apparatus is made of a dark box provided with lenses like a camera. At the focus where the sensitive plate is ordinarily exposed to the action of light is placed an open disc made of very thin and light material, mounted on a shaft. This disc is shown in front view[2] in Fig. 1 and in side view at A B, Fig. 3. Pin holes, about $\frac{1}{100}$ of an inch in diameter, are perforated near the periphery on concentric arcs of circles, the difference between the radius of two succesive arcs being $\frac{1}{100}$ inch, while the distance between two holes is equal to the width of the image painted by the rays of light on the upper part of the disc.

The number of the perforations is such that the total of their diameter is equal to the height of the image. The holes being thus dispersed on the surface of the disc, and the disc revolving, the perforations traverse the surface of the picture according to different concentric lines and the rays of light pass successively through the disc when the perforations are moving past them.

The conversion of the rays of light into electric currents of proportional intensity is effected by a special selenium cell of an extreme sensitiveness acting by the influence of the heated light. There has been considerable debate as to whether the changes in the resistance of the selenium are due to the light or the heat. In fact, I believe as the result of my own experiments that in most of the cases the increase in the intensity of the current is due to the combined action of both.

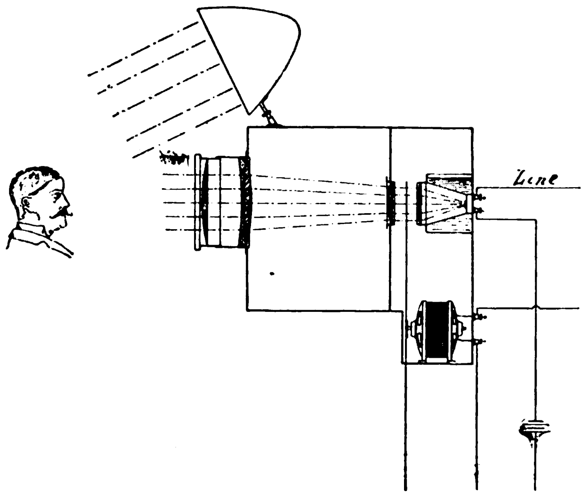

FIG. 2.—TELECTROSCOPE TRANSMITTER.

The variation that will occur in the resistance of the selenium cell, upon which falls a beam of heated light, will be greatly increased if the difference between the temperatures of the selenium and the rays of light is as great as possible.

In order to obtain this result I direct the light of a projector located on the top of the apparatus toward the object whose picture is to be transmitted to a distance, and I use preferably a source of light giving very hot rays—calcium light for instance; thus the temperature of the light rays reflected by the object and directed by the lenses on the surface of the selenium is higher, and therefore the effect is increased; but in some cases it is not possible to raise the temperature of the illuminating rays above a certain limit. To remedy this inconvenience, I cool the selenium cell by placing it inside a conical cavity forming part of a receptacle containing a cooling mixture, Fig. 2; the cone is closed at its base by a lens facing the disc, and directed at its focus where the selenium cell is exposed, and the rays of light pass through the perforations of the disc. By this disposition the difference in the temperature of the heated light rays and the selenium is as great as possible, and consequently the variation of the current is a maximum. The selenium cell is made of strips of tin foil separated by narrow strips of dry paper—the pile is held by a clamp, and its face covered by a coating of selenium, which in turn is covered by a very thin coating of lampblack.

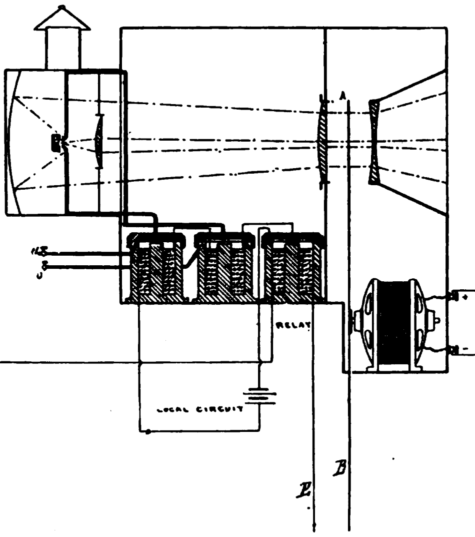

FIG. 3.—TELECTROSCOPE RECEIVER.

With the apparatus thus constructed, it can be easily understood that if the disc is caused to revolve, each of the rays of light forming the picture will successively set up in the line currents of varying strength. These currents act at the receiving apparatus upon a miscrophonic relay acting on the telephone receiver, shown in Fig. 3, modified by the addition of a narrow chamber placed between the disc and a cover hermetically closing the telephone. One of the chambers is full of oxygen, brought in by a pipe, and the other is full of hydrogen. On the top of the covers is tubing properly adjusted and provided with regulating valves. The two gases are brought under pressure near the surface of a cylinder of carbonate of calcium.

The variations in the strength of the current of the microphonic relay, cause pulsations of the diaphragms. But those pulsations, even if they are of a molecular nature, impart to the molecules of the gas an excess of speed, causing proportional variations in the intensity of the oxy-hydrogen light. A lens and a reflector concentrate the light on a ground glass screen after having previously passed by one of the perforations of a disc absolutely similar to the disc placed in the transmitting apparatus. Then, according to the position occupied by the perforation on the surface of the disc, the beam of light passing by this point makes a more or less luminous point some place on the ground glass.

But as the two discs are revolved synchronously by the two pulsating current motors, whose pulsations are controlled and even created by the vibrations of a tuning fork, when the light of the receiver passes through a certain perforation of the receiving disc one of the rays of light emitted by the object passes by the same perforation of the transmitting disc. If the disc turn slowly, each ray of light emitted by the different points of the object placed in the field of the transmitting apparatus is converted into an electric current of proportional intensity, which current is re-converted at the receiving apparatus into a beam of light of proportional intensity, and if a sensitive plate were substituted for the ground glass, a picture would be taken of the object in view of the transmitter after a complete revolution of the disc. But if the discs are revolved at the rate of ten revolutions per second, each point of the ground glass is more or less luminous or dark ten times a second, and on account of the persistence of vision the retina is not affected by the successive disappearance of the points, which, taken together, reproduce exactly the object placed before the transmitter. It does not matter if this object moves, because the image in the receiver is modified accordingly.

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[1] Abstract of a paper read before the Pittsburgh Electric Club.

[2] We are indebted to *Electricity* for the illustrations.

LITERATURE.

The Philosophy of Individuality of the One and the Many. By Antoinette Brown Blackwell. *New York,* G. P. Putnam's Sons, 1893. 8vo., pp. x 520. (Ill.). Price, $3.00.

The problem of the nature and constitution of matter is one which from time immemorial has formed the subject of much acute speculation. The materialists have always held, more or less distinctly, the theory which appears to have been first propounded by Democritus of Abdera.—one of the Ionian philosophers who apparently devoted their lives to the search for a single material principle which should explain the philosophy of the universe,—according to which all matter, in its ultimate analysis, is reduced to aggregations of indivisible particles. In more recent times, the majority of philosophers no longer regard matter as something without life, and capable of being separated from force, but as inherently endowed with all the innumerable potencies of which the visible universe constitutes the existing manifestation. But there has also existed another school of philosophers, who, like Bishop Berkeley, have gone so far as to deny the actual existence of matter altogether. Yet it must be admitted that if we attempt to conceive of the ultimate atoms of matter as hard and infinitesimally minute spheres, we are at once confronted with the apparently insuperable difficulty of explaining their elasticity and many other mutual interactions. Faraday appears to have regarded these atoms in some sort as centres of force; Rankine as nuclei, enveloped in an etheric atmosphere filled with complicated whorls; while Thomson has distinctly formulated the interesting hypothesis that each atom of what we call matter is but one of an infinity of vortex-rings in the universal ether. In his address before the British Association at Montreal in 1884, he observed that "it is scarcely possible to help anticipating in idea the arrival of a complete theory of matter in which all its properties will be seen to be merely attributes of motion." Thomson's hypothesis, therefore, assumes our perception of matter to be a phenomenon essentially correlative with that of our perception of the radiant energies, or in other words, that it is a perception of matter as a mode of motion of the universal ether. The next question which confronts us is, What is the probable character of this motion? Do these centres of motion rotate or oscillate about fixed points in space, or have they, in addition to their inherent intrinsic motion, whatever it may be, a motion of translation also?

These and other kindred inquiries form the subject of the work before us, the work of an indefatigable student, and of a bold and original thinker. The underlying proposition of the author may perhaps without liability to serious misapprehension, be paraphrased in half-a-dozen words; "matter and motion constitute the universe; matter and motion are one and inseparable, and that one is motion;" or perhaps even more clearly in her own words: "Everything which occurs in space and time is a product of changes correlated in space and time. A rhythmic atom of matter is one continuity of simultaneous and successive dependant changes correlated in space and time." And it is just here, in the conception of the "rhythmic atom" that the author has pushed the kinetic theories of matter even beyond the hypothesis of Thomson, assuming as she does the position that in every form of motion, absolute reciprocity must be an inherent characteristic. Harmonic or rhythmical motion of the unitary ultimate atom, is therefore the key with which the author has sought to gain access to the secrets of the universe; she has, moreover, fearlessly sought to test its sufficiency by attempting the explanation of some of the principal types of physical phenomena through one and the same correlated principle, among others, gravitation, light, heat, sound, electricity and magnetism; and not content with this, she appeals to numerous well-known facts, tending to support the hypothesis that the same principle is adequate to explain and harmonize, not merely material, but mental phenomena. It is not within our province to discuss this latter phase of the question, but we may at once admit, that so far as the phenomena of electricity and magnetism are concerned, there is certainly not a little to be said in favor of the general view of the author.

It has been said of Faraday, that he so lived among phenomena that they yielded their hidden secrets to him in a way wholly unintelligible to ordinary workers; it is at least certain that although he often arrived, as it were, intuitively, at truths of transcendent importance, he was not always able to express his thoughts in language intelligible to his contemporaries, so that the true inward significance of his results, and of his speculations thereupon, might be fully comprehended. The same difficulty, in an enhanced degree, must be encountered by one who seeks to grasp and fully comprehend the chain of reasoning by which the author of this work has sought to unravel the intricate labyrinth of mutual correlation between the different classes of physical phenomena, of which we profess to have learned so much, and of which we really know so little. Faraday is said to have once confessed himself in a state of almost hopeless ignorance of the true nature of electricity. Spencer, taking the ground that inasmuch as heat and light had been proven to be modes of motion, therefore electricity must necessarily fall into the same category, advanced the theory that all the phenomena of electricity might be referred to the interference of differently vibrating molecules. But we think that modern research has shown the premise of Spencer to be untenable. Even Franklin had long before perceived that electricity could neither be created nor destroyed, but that it might be moved from one place to another; that what of electricity one body gains another must lose; in short, that in many respects, electricity behaves like a material substance. Hence it can no more be possible to "generate" electricity than to create matter. The view of the author may in a certain sense be said to harmonize the conception of Spencer with the later views of Maxwell and Lodge. It is in effect that electricity is not a vibratory motion *of* something, as assumed by Spencer, but a vibration *in* something, as the experiments of Herz seem to have conclusively demonstrated. The fact that in attempting detailed explanations of particular phenomena the author has apparently been misled by the conventional expressions in common use to suppose that electricity in a circuit moves in one direction or in the other, or that there may be some inherent difference of constitution between frictional, chemical and magneto electricity, does not necessarily vitiate the general conclusions reached. The observed phenomena of electricity and magnetism, when rightly interpreted, certainly do not seriously conflict with the hypothesis which the author has worked out with such painstaking elaboration. We may mention, too, that an even stronger confirmation than that cited by her of the truth of the proposition that sound does not consist of a given number of countable wave-beats, but is rather a true inter-atomic rhythm, may be found in the well-known fact that a plate of iron even an inch thick, when used as the diaphragm of a telephone, will respond to and transmit perfectly the sound-vibrations of the human voice, a result which it is almost inconceivable to suppose could be effected by mere mass vibration.

It is not a little interesting to note the clear perception at which the author has arrived, apparently upon purely theoretical grounds, of the important truth, so generally overlooked, that electricity can only exist where there is either a conductive or an inductive circuit. The text-books and treatises on electricity might, we had almost said, be searched in vain for an allusion to, much more an adequate explanation of, the phenomena of the inductive circuit, although it was clearly apprehended by Gaugain, certainly as early as 1861, while Webb, in 1862, pointed out the applicability of Ohm's law thereto, citing numerous examples of complicated cases, in a published treatise of great ability, far less well-known than it deserves to be.

Much more might be written on this interesting subject did not the limits of our space forbid. Those interested in speculations on the ultimate nature of things may discover abundant food for thought in this work, but we warn them that they will find it by no means easy reading. The topic is an abstruse and difficult one at best, and the style of presentation is, to say the least, perhaps not so clear as it might be; but this is no more than might be truthfully affirmed of more than one work which has nevertheless served to render the name of its author illustrious and to mark an epoch in the annals of philosophy.

LETTERS TO THE EDITOR.

MR. C. E. L. BROWN'S ALTERNATING MOTORS.—A REPLY TO MR. ARNOLD.

HERR ARNOLD in his last article attempts to treat my work on alternate current motors, dating, as it does, from 1891, as having been anticipated. For example, he mentions a patent of Tesla, of which he must be well aware that a machine built in such a way would not work. He further wishes it to be believed that the hole-wound armature was invented by Wenström, whereas he must know, first, that Wenström never patented a hole-wound armature but one with slots, and second, that the use of the hole armature for multiphase motors was first proposed by me.

He further says that the single-phase motor is the natural consequence of the development of the multiphase motor, and this is certainly more or less the case. But he seems to quite forget whence these improvements came, and overlooks the fact that this development was, after all, not such a very natural one, as Herr Dobrowolsky for example, in a letter to the *Electrotechnische Zeitschrift*, disputes the possibility of producing a good practical single-phase motor, although he has been building multiphase machines for some years.

The position taken by Herr Arnold in refusing to see anything new in my method after he has heard about my results is certainly easily understood.

C. E. L. BROWN.

BADEN, Switzerland.

MR. F. GIBSON has left Whitinsville, Mass., to take charge of the Canton, Mass., electric light plant, recently bought by Mr. P. Burbank.

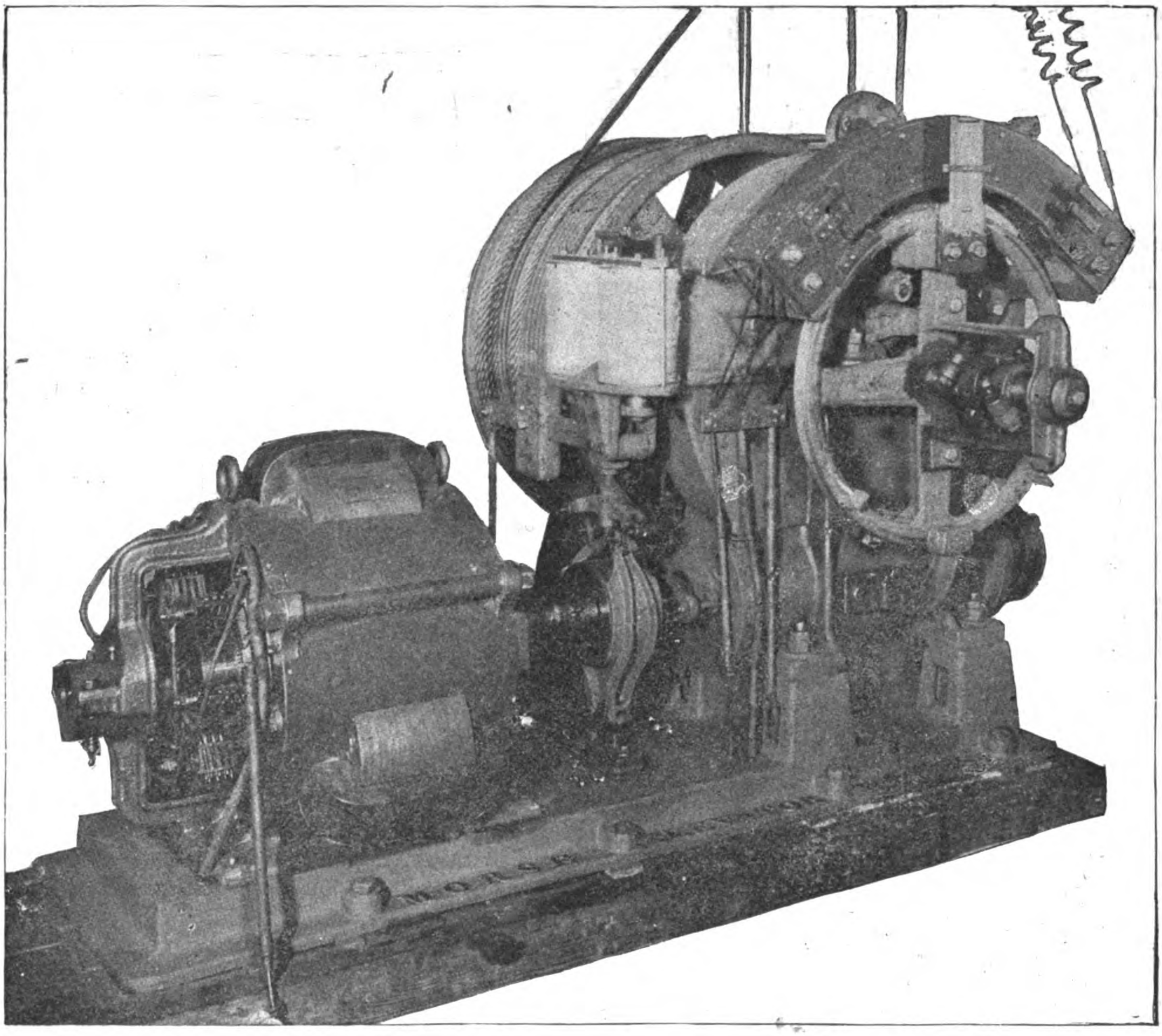
THE MORSE-WILLIAMS ELECTRIC ELEVATOR.

The accompanying engraving represents the arrangement adopted by Messrs. Morse, Williams & Co., of Philadelphia, in their new type of electric elevator. The machine has been designed especially with a view of obtaining simplicity of construction, accessibility of parts for repair and smoothness in running—the latter exceedingly important feature being attained by the use of the Hindley worm gearing, the manufacture of which has been made a specialty for years. The machine consists of a worm of bronze or steel and a wheel incased in an oil-tight housing; the thrust of the worm shaft is taken on hard metal buttons revolving in oil.

The motor is attached to the worm shaft by means of a coupling. The worm shaft is provided with a powerful double-shoe brake, which is released by the action of an electromagnet and is applied by a weight. The special advantage of this arrangement is shown in case the electric current from any cause should be cut off, when the brake would be instantly applied, thus stopping the machine. The brake is so constructed as to act as a governor in checking the descent of the car, should it be accelerated beyond the normal speed at which the motor is designed to run it.

The drum upon which the cables wind is grooved in the lathe and keyed fast to the heavy shaft, to which the worm wheel is also keyed. This shaft is provided with stop collars and nuts arranged to stop the car at terminal landings independent of the operator. The slack cable stop arrangement is also a feature of this machine; it stops the machine automatically in case the car should become obstructed in its descent and stop. Without such an attachment there would be an unwinding and consequent entanglement of the cables with the machinery.

The motor, built by the Elektron Manufacturing Co., is of the low-speed, multipolar type; the bearings are self-oiling; carbon brushes are used, requiring a minimum of attention. The reversing switches and controlling apparatus are of simple and improved forms, their action causing the elevator to start easily and gently with and without a load. The whole apparatus is placed upon a heavy cast-iron bed plate and the motor is thoroughly insulated therefrom when a high tension current is used, to obviate danger of shock in the car. The machines are designed to raise average loads at speeds as high as 250 feet per minute. We are indebted to the *Iron Age* for the illustration.



MORSE-WILLIAMS ELECTRIC ELEVATOR.

A "LONG-DISTANCE" YARN FROM EUROPE.

We clip the following from the *National Advertiser*. The item shows that Eastern Europe can hold its own with the wild and woolly West for exaggeration. But why should an intelligent American journal print such a yarn as true?

> The telephonic newspaper of Buda-Pesth, which was mentioned in a recent issue of the *National Advertiser*, is meeting with many difficulties. Several persons, who complain of being telephonically libelled, have instituted suits against the projectors of the enterprise, and Hungarian lawyers are now struggling with the problem whether libels by telephone are actionable. The Government, it is said, also regards the experiment with disfavor, because of the difficulty of exercising the power of censorship. Notwithstanding these setbacks, the scheme has been a complete success. *There are now subscribers in every town in Hungary possessing the telephonic system.* One transmission enables every subscriber to hear the editorial voice with perfect ease. The electricians in charge say that if there were *a half million subscribers scattered all over Europe each one would distinctly hear the voice of the editor in Buda-Pesth.*

Change of Name.—The name of the *Railroad and Engineering Journal* has been changed to the *American Engineer and Railroad Journal*, which will be published and edited by Mr. M. N. Forney, at 47 Cedar street.

REPORTS OF COMPANIES.

ANNUAL REPORT OF THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY.

PITTSBURGH, PA., May 17th, 1893.

To the Stockholders of the Westinghouse Electric and Manufacturing Company:

YOUR Board presents herewith its financial statement for the year ending March 31st, 1893.

It will be seen that there has been a profit from manufacturing of $1,491,817.13, and from other sources of $112,766.60, making a total for the year of $1,604,583.73. This is after charging to operating expenses the following amounts: $84,747.31 for alterations to buildings; $155,484.87 for maintaining the machinery and tools in the highest order, and $58,188.86 for interest and discount.

The year began with large orders, but with only a moderate manufacturing capacity and a proportionate stock of material on hand, so that the above earnings were made under unfavorable circumstances due to the fact that the capacity of the works and the material in stock and in process had to be more than doubled during a steadily increasing press of business.

During the year the company has manufactured, and installed at the World's Fair in Chicago, an electric lighting and power plant, consisting of 12 generators of 15,000 lights capacity each—two of 4,000 lights capacity each, one 750 h. p. generator, and several smaller ones. Six of the large generators are driven by engines having their shafts connected directly to those of the generators. This plant is the largest ever installed.

These generators mark a new era in electric light and power distribution. They are of the "two-phase" type, designed to drive Tesla motors, and at the same time to operate both arc and incandescent lamps, thus making the one form of generator useful for three purposes.

The total capacity of the plant exceeds the contract requirements sufficiently to meet the demands that may be made by exhibitors for extra lights.

The company will also have at the Fair an extensive exhibit of its other forms of apparatus.

The stopper lamps now being manufactured in the company's Allegheny City works are being used exclusively in connection with the apparatus at the World's Fair. It is gratifying to be able to announce that in the manufacture of the Sawyer-Man stopper lamps, all of the advantages anticipated have been fully realized. The low cost of manufacture, and the high efficiency of these lamps, together with the ability to renew their carbon burners, enables the company to sell lamps at lower prices than can be afforded by any other manufacturer. To meet the demand a new factory has been equipped with special machinery designed for the purpose, and already has a daily capacity of 5,000 lamps, which is being rapidly increased, and will be shortly quadrupled. The expenses incident to the establishment of this new lamp factory have been charged to the business of the past year. This branch will hereafter add materially to the volume and profit of the company's business.

The success of the stopper lamp, its low cost of manufacture, and the fact that it is the discovery, prior to Edison's patents, of inventors whose patents belong to our company, have turned a temporary check into a great business advantage.

Our competitors have copied our plans and infringed many of our patents, notably those relating to power transmission, and many important details essential to the successful operation of alternating current apparatus for the distribution of electricity for light and power purposes, for which we have brought suits for infringement.

The confidence expressed in the last annual report, in the superior merit of the apparatus of the company, and in the strength and value of its patents, has been fully justified by the results of the year's operations; and we feel no apprehension as to the outcome of suits now pending or which may be brought by its competitors.

Your directors have been brought face to face with the fact that the business of the company has outgrown the present capacity of its factories, and that large savings could be effected if the manufacture were carried on in new works equipped with the latest devices for handling its product by machinery.

In view of the favorable result of the past year's business, and of the volume of orders in hand, and the future outlook, your directors have not hesitated to accept a proposition from the East Pittsburgh Improvement Company to sell to your company a site of 23 acres most favorably located with reference to railway facilities. The Improvement Company has agreed to erect on this site buildings and works according to the plans and under the supervision of the officers of your company, and to sell them to the company at their actual cost, not, however, to exceed $500,000 above the price of the land, and have agreed to take pay therefor in quarterly payments of $25,000 and interest, beginning January 1st, 1894. Your officers have estimated that the savings to be effected by the manufacture of its products in the new works, will, on a most conservative basis, be more than double the amount of the quarterly payments. Thus, these new and complete works will be acquired without the expenditure of fresh capital, leaving the proceeds from the sale of the company's present property, as working capital, without taking into account the manifold business advantages that will arise from the centralization of its manufacturing operations.

The results of the past year's business have shown that our apparatus can be sold for cash to responsible parties, and that the prevailing belief that long credits must be given, or that stocks and bonds must necessarily be taken in order to secure business, is not correct. Your officers and agents have found that low cash prices and good apparatus are sufficient inducements to secure all the trade the company can care for.

Although the profits of the business might have justified the payment of dividends on all of the stock of the company, the directors have thought it wise to pursue a very conservative policy, especially in view of the large expenditures required during the past year for machinery and material, and of similar expenditures which the present prosperous condition of the company's business may make necessary in the near future. Both the results and the prospects are so encouraging that the directors believe the stockholders will uphold them in a course which places the company in a position of undoubted financial strength, and which will assure the permanent continuance of dividends when once begun.

For the Board,
GEORGE WESTINGHOUSE, JR.,
President.

BALANCE SHEET, MARCH 31, 1893.

ASSETS.

Cash in Banks	$212,578 85
Bills receivable	366,228 47
Accounts receivable	2,289,968 70
Material in stock and in process of manufacture (at cost of labor and material)	1,414,662 31
Advances to leased companies	138,573 06
Bonds (par value $369,100)	358,197 15
Stocks (par value $6,469,257)	4,069,439 96
Real Estate and Buildings	453,037 98
Machinery and Tools	710,028 61
Miscellaneous	60,055 54
Charters, Franchises, Patents, etc.	4,378,031 69
Total Assets	$14,450,806 32

LIABILITIES.

Accounts payable			$569,660 48
Bills payable, issued for Merchandise			376,003 64
Discounted with collateral			931,884 51
CONTRACT AND CONTINGENT LIABILITIES.			
Scrip Dividend			194,562 00
Stock Subscriptions			13,125 00
U. S. E. Ltg. Co.'s 6 per cent. 15 year bonds, $50,000 payable annually			600,000 00
(Bills receivable under discount, $482,054 49.)			
CAPITAL STOCK.			
Preferred, 73,878 shares		$3,668,940 50	
Assenting, 103,146 shares		5,157,331 00	
Common, 3,633 shares		181,650 00	
			9,007,921 50
(In Treasury, 6,621 shares Preferred; 18,220 shares Assenting.)			
SURPLUS.			
Balance, March 31, 1892		$1,880,445 20	
Twelve months net earnings from business	$1,491,817 13		
From other sources	112,766 60		
		1,604,583 73	
		$3,485,028 93	
Less amount written off in adjustment of matters pending in 1890 and 1891	$321,228 05		
Ditto in current year	98,869 65		
		$420,097 70	
		$3,064,931 23	
Interest on Bonds	$39,000 00		
Interest on Scrip	11,673 72		
Dividends	256,608 32		
		$307,282 04	
			2,757,649 19
			$14,450,806 32

GENERAL ELECTRIC FINANCES.

PRESIDENT C. A. COFFIN issued last week an indignant denial of the statement that the General Electric Company was to be reorganized or needed reorganization. He says that the company was never in easier financial condition than it is to-day, and that its obligations and those of its underlying companies have been reduced $2,000,000 since the annual statement at the end of the fiscal year. Of the contracts on its books, 80 per cent. are for cash, and the other 20 per cent. for well-secured notes.

LEGAL NOTES.

EDISON FIXTURE PATENTS.—RECOVERY FOR INFRINGEMENT BY USERS DENIED.

UNITED STATES CIRCUIT COURT. SOUTHERN DISTRICT OF NEW YORK.

Edison Electric Light Company, *et al. vs.* The Equitable Life Assurance Society of the United States.

In Equity. On bill and plea alleging laches and acquiescence in defendant's alleged infringement for 11 years. Eugene H. Lewis, for Complainants. Leonard E. Curtis, for Defendant.

COXE, *J.*:

The defendant asks by the plea to have the bill dismissed on the ground of laches. No authority for this practice in an infringement suit is cited by counsel. There is no doubt, however, that the defense of the statute of limitations may be presented by plea. 2 *Dan. Ch. Pl. & Pr. vol.* 2, 728; *Story Eq. Pl. Sec.* 757. It has also been held that a party, who for 40 years had been in peaceable possession of premises sought to be recovered, could present the question of laches by a plea. *Blewett* v. *Thomas* 2 *Ves. Jr.* 669. So in an action for rent, the defense of 26 years undisturbed possession was interposed by plea and sustained. *Baldwin* v. *Peach*, 1 *Young & Coll.* (*Ex. Rep.*) 453; *Story Eq. Pl. Sec.* 814; *Cooper's Eq. Pl.* 288. In *Landsdale* v. *Smith*, 106 *U. S.* 391, it was held that the defense of laches might be asserted by a demurrer, although it could also be presented by plea or answer.

On the other hand the trend of modern decisions is against trying causes piecemeal and in favor of relegating defences which go to the merits, to the domain of the answer. *Rhode Island* v. *Massachusetts*, 14 *Peters*, 210,257; *Sharp* v. *Reissner*, 9 *Fed. Rep.* 445; *Korn* v. *Wiebush*, 33 *Fed. Rep.* 50; *Bailey* v. *LeRoy*, 2 *Ed. Ch.* 514. In *Walker on Patents* the author, at section 597 says "A plea is not appropriate for such a defence (laches), because if the bill shows delay and is silent about excuses therefor, the method of a plea would be to state that there is no such excuse and because, by taking issue on such plea, and proving an excuse, the complainant could cut off all other defences, and win the cause." It will be observed that the learned author does not pronounce the plea an improper pleading, but only inappropriate and unwise.

Although no exact precedent has been found the court is entirely clear, after an extended examination of analogous cases, that this plea was properly filed. By setting it down for argument the complainants have admitted the facts therein alleged to be true. Briefly stated these facts are that third parties have openly infringed the patents for 11 years with the knowledge of the complainants and their predecessors; that the defendant is not a maker and seller, but only a user of the alleged infringing articles and has, as the complainants well knew, been using such articles openly and notoriously, for the last 11 years, as a part of the apparatus for lighting its building in New York city; that although continuously within the jurisdiction of this court and abundantly able to respond in damages the complainants have never given any notice to the defendant or asserted any claim under either of the letters patent mentioned in the bill.

The question, then, is this: Can a patentee maintain an equity action of infringement against a mere user who has used the patented structure openly for a period of 11 years with the full knowledge of the patentee and without objection from him? It is thought that this question must be answered in the negative. *Hammond* v. *Hopkins*, 143 *U. S.* 224; *Galliher* v. *Caldwell*, 145 *U. S.* 368; *Foster* v. *Railroad Co.*, 146 *U. S.* 88; *Landsdale* v. *Smith*, 106 *U. S.* 391; *Robinson on Patents, vol.* 3, *Sec.* 1194 *and cases cited in Kettle* v. *Hall*, 20 *Fed. Rep.* 508.

The bill alleges that the defendant has been infringing "*ever since* the 27th day of December, A. D. 1881." In *Brush Electric Co.* v. *Ball Electric Co.*, 43 *Fed. Rep.* 899, this court had a similar allegation under consideration and, by implication decided that a bill which alleged a continuous infringement for 10 years without excuse, was bad on demurrer. The bill in that case was saved, however, because the word "since" was construed to mean not "ever since," but "subsequently to" the date of the patent.

The case at bar differs in many respects from the cases cited in support of the bill chiefly because it is affirmatively established by the allegations of the plea that the patents were plundered openly and continuously by the public without complaint by the owners of the patent, and that the defendant's alleged infringement was well-known to them during eleven years and was acquiesced in without even a notice to desist. The fact, too, that the defendant is only a user would seem to dispose of the doctrine applicable to a multiplicity of suits as well as other grounds of equitable cognizance.

It must be conceded within all the authorities that, upon the admitted facts here, an accounting as well as a preliminary injunction are out of the question, and it is difficult to imagine upon what theory a permanent injunction can issue. The theory of the rule is that as the defendant has used these fixtures for eleven years with the permission of the complainants they cannot now complain of their use. If the defendant were making and selling new fixtures and thus interfering with the complainant's business, the rule might be different, but it would seem that the rights of the parties are fixed and determined as to the structures which the defendant has used so long with the complainant's implied consent. In other words, the complainants can only be injured to the extent of their license fee and the right to recover that has been lost by their own negligence.

The doctrine of *McLean* v. *Fleming* 96 *U. S.* 245 and *Menendez* v. *Holt*, 128 *U. S.* 514, 523, is invoked by the complainants. Although both these cases relate to trademarks no reason is perceived why the principle there enunciated should not be applicable to patent causes, but it is thought that it is not applicable to the facts in hand for reasons already given.

It was stated at the argument that there was ample excuse for the apparent delay in bringing the action, and that one object in setting the plea down for argument was to have a precedent established by a determination of the question, whether the complainant should allege his excuses for delay in the bill or reply to the allegations of the answer setting up the defense of laches. The Court is of the opinion that, even if the complainants are right upon the proposition that the bill in its present form can be sustained for a portion of the relief prayed for, it is much wiser and safer to amend the bill by setting up all the facts upon which they rely. Where the delay appears upon the face of the bill the excuse should appear also.

In *Badger* v. *Badger*, 2 *Wall* 87, the Court says, that the complainant in a suit in equity "should set forth in his bill specifically what were the impediments to an earlier prosecution of his claim; how he came to be so long ignorant of his rights, and the means used by the respondent fraudulently to keep him in ignorance and how and when he first came to a knowledge of the matters alleged in his bill; otherwise the chancellor may justly refuse to consider his case, on his showing, without inquiry whether there is a demurrer or formal plea of the statute of limitations contained in the answer." It is thought, therefore, that the plea must be allowed, but with leave to the complainants to amend their bill within twenty days.

SUIT FOR INFRINGEMENT OF THE BRUSH STORAGE BATTERY PATENT.

THE suit of the Consolidated Electric Storage Company against the Milford & Hopedale Street Railway Company was up for hearing before Judge Colt in Boston on May 9 and 10. The suit is brought for infringement of the Brush Storage Battery patents. The battery employed by the Milford & Hopedale Company, is the invention of Mr. Edw. P. Usher. The active material is put on in powdered form between thin paper-like lead sheets and folded up into the usual size of plate, which is then perforated. Messrs. Witter & Kenyon, Bentley & Blodgett, and Charles E. Mitchell counsel for the complainants. Messrs. W. B. H. Dowse, Louis D. Brandeis, and W. S. Hall, for the respondents.

A TROLLEY PATENT SUIT IN NEW HAVEN, CONN.

A SUIT for infringement and damages has been brought against the Winchester Avenue and West Haven Electric Road in New Haven and the Westinghouse Electric and Manufacturing Company. The suit is one to restrain these concerns from using the trolley under the Van Depoele patents recently granted. The papers were drawn up by Betts, Atterbury, Hyde & Betts of New York, as attorneys for the General Electric Company, at whose instance the suit is brought. It is understood that the damages are laid at half a million dollars.

THE SAWYER-MAN LAMP CASE IN THE SUPREME COURT.

A PETITION was presented to the United States Supreme Court last week asking the court to bring up for review and determination the case of the Edison Electric Light Company et al *vs.* the Sawyer-Man Electric Company now pending in the Circuit Court of the Southern District of New York. In support of the petition an additional brief was filed by B. H. Bristow, which presents the arguments for the granting of the petition.

In the court below, the Edison Company sued for an injunction against the Sawyer-Man Company to prohibit it from manufacturing a lamp said to be an infringement of a patent granted to Edison in 1880, which had been held to be valid in another proceeding. Counsel for the Sawyer-Man Company contend that the injunction sought ought not to be issued for these reasons:

1. That the Edison Company has been guilty of laches. Although the patent was issued in January, 1880, no action was taken to prevent its infringement until May, 1885. During all that time competitors of the Edison Co. were engaged in the business of furnishing electric light plants without objection, and stockholders of these and other companies were thereby induced to invest their money in similar enterprises. All this investment, estimated at $25,000,000, is at stake, and the court ought not to

permit the Edison Company, after sleeping on its rights five years, to reap the benefit of the pioneer work done by its competitors, the result of which had been to make the business remunerative.

2. That the Edison Company is a part of a combination, the very existence of which is unlawful. Its purpose is to create and maintain a monopoly of the electric lighting business, and it cannot, therefore, have the aid of the Court in carrying out the illegal purposes of its organization.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED MAY 9, 1893.

Alarms and Signals:—

Shoplifting Detector, F. Sturtevant, Charlestown, Mass., 497,062. Filed Jan. 17, 1893.

An electric device operated by an increase or decrease of weight upon a shop counter.

Signal-Transmitting Apparatus, M. Martin, Malden, Mass., 497,281. Filed Aug. 20, 1892.

Improvement upon the invention shown in the same inventor's patent No. 459,018, of Sept. 8, 1891. Especially adapted to fire-alarm telegraphs.

Batteries, Primary:—

Galvanic Battery, C. W. Holtzer, Brookline, Mass., 496,878. Filed Nov. 14, 1891.

Relates to the form and construction of the elements.

Dynamos and Motors:—

Method of Making Conductors for Armatures, R. E. Crompton, Chelmsford, Eng., 497,001. Filed March 26, 1892.

Forms the conductor by laying together a bundle of wires, twisting them, and then compressing them into any desired cross section.

Multiphase Electric Motor, P. A. N. Winand & C. O. C. Billberg, Philadelphia, Pa., 497,110. Filed March 22, 1892.

Claim 1 follows:—

An electrical appliance for the employment or generation of multi-phase alternating currents, consisting of a core wound with coils, the coils for the different phase currents being wound to overlap each other with diminishing magnetic effect.

Transformer Motor, O. T. Bláthy, Buda-Pesth, Austria-Hungary, 497,118. Filed March 24, 1891.

Consists of an electro-motor for alternate currents which may be considered as composed of a transformer and a motor part changing roles periodically.

Commutator for Electric Generators or Motors, M. W. Hassan, Rochester, N. Y., 497,123. Filed March 16, 1893.

Aims to increase the area of the insulation between the segments.

Pedal Switch for Electric Motors, L. Teal, Philadelphia, Pa., 497,144. Filed Jan. 18, 1893.

Lamps and Appurtenances:—

Electric Arc Lamp, M. Krueger, Chicago, Ill., 496,882. Filed Oct. 5, 1891.

Adapted for use behind the scenes of theatres for obtaining stage effects.

Electric Lamp, J. Waring, Manchester, Conn., 497,088. Filed Jan. 4, 1893.

An incandescent lamp. Claim 1 follows:

The combination of a carbon to be raised to incandescence by electrical excitement, an enveloping gas composed wholly or largely of an element or elements of high-atomic weight, to wit, as high as that of bromine, a sealed chamber inclosing both the carbon and surrounding gas, and electrical conductors passing through the walls of said chamber and connecting with the carbon, for the purpose specified.

Automatic Switch for Mast Arms, W. A. Turbeyne, Detroit, Mich., 497,104. Filed Nov. 5, 1892.

Designed to cut out an arc lamp by the lowering of the mast.

Electric Lamp Support, J. Nortney and F. Schefold, New Albany, Ind., 497,200. Filed Dec. 22, 1892.

For arc lamps.

Measurement:—

Electric Meter, O. Ericsson, Sioux Falls, South Dakota, 496,871. Filed May 6, 1892.

For registering consumption in a three-wire system. Employs a number of separate meters to measure the current in separate circuits and a single-counting mechanism registering the sum of the currents through all the meters.

Metallurgical:—

Magnetic Ore Separator, C. G. Buchanan, New York, N. Y., 497,117. Filed May 17, 1892.

Retains the metallic particles upon a cylinder subject to a magnetic field and permits the non-metallic particles to drop off by gravity.

Metal Working:—

Method of Welding Metal, A. J. Moxham, Johnstown, Pa., 496,890. Filed June 27, 1892.

Forms the adjacent ends of the pieces to be welded with advance contact portions, and passes the current while exerting pressure on the pieces.

Miscellaneous:—

Switchboards for Electric Circuits, A. L. Rohrer, Lynn, Mass., 496,901. Filed June 20, 1892.

A safety device to protect operators or other persons from a possibility of shocks by touching the metal parts.

Safety Connection for Induction Coil Systems, E. Thomson, Lynn, Mass., 496,918. Filed Oct. 8, 1888.

Especially designed for use in systems of distribution employing transformers. Employs a high resistance ground connection from a part of the circuits normally disconnected from the main circuit and means for substituting a low resistance connection through the action of high tension current accidentally escaping from the main circuit.

Electric Traveling Crane, W. H. Morgan, Alliance, O., 496,945. Filed June 13, 1892.

Provides means for controlling the travel of the crane and the movement of the trolley from a point of observation in the shop, rather than from within a cage suspended from the bridge.

Electrical Circuit, C. E. Chinnock, Brooklyn, N. Y., 497,120. Filed Dec. 17, 1891.

Provides a shunt to divert lightning from an electric generator without offering retardation through induction.

Portable Electric Abrading Device, A. J. Nellis, Pittsburgh, Pa., 497,197. Filed Dec. 12, 1892.

Adaptation of an electric motor to a planing, grinding, abrading or polishing machine.

Electric Time Stock-Feeder, H. S. Page Medford and L. Spear, Boston, Mass., 497,203. Filed Oct. 12, 1892.

An electro mechanical releasing device adapted for the periodical supply of food to horses or other animals.

Influence Machine, H. E. Waite, New York, N. Y., 498,236. Filed Dec. 5 1892.

Provides especially for surrounding the generating plates with dry air at all times. Encloses them in an air-tight case.

Coupling for Electric Light and Gas Fixtures, G. Peeples, Philadelphia, Pa., 497,251. Filed Nov. 19, 1892.

Electric Cigar Lighter, W. P. Carstarphen, Jr., Denver, Colo., 497,263. Filed Nov. 7, 1892.

Adapted for use on alternating current circuits.

Railways and Appliances:—

Contact for Underground Electric Railways, W. Q. Prewitt, Lexington, Ky., 496,896. Filed May 19, 1892.

Employs an automatically operable latch for connecting and disconnecting the contact device from the shank.

Electric Railway, R. M. Hunter, Philadelphia, Pa., 497,024. Filed June 21 1886.

Claim 1 follows:—

The combination of an electric railway of a sectional line conductor extending along the railway, a supply conductor also extending along the railway, electrical switches connecting the supply conductor with the respective sections of the sectional conductor to permit a large flow of current therein upon the passing of a vehicle, a stationary source of electric supply, an automatic regulator to control the current delivered to the supply conductor, and a return circuit also extending along the railway and connecting with the source of supply.

Overhead Electric Railway, R. M. Hunter, Philadelphia, Pa., 497,025. Filed Sept. 23, 1886.

Claim 1 follows:—

In an electric railway, the combination of a suspended electric working conductor, a stationary source of electric energy to supply electricity thereto, a traveling vehicle, tracks for said vehicle parallel to said working conductor, an electric motor on the vehicle to propel it, a motor circuit and hand regulator on the vehicle, and a traveling collector having its weight sustained and moved by said vehicle and consisting of a support having a grooved contact wheel making contact with the under side of said suspended conductor and supplying current to the motor circuit.

Trolley Wire Support, H. A. Hamlin, Minneapolis, Minn., 497,293. Filed June 18, 1892.

Electric Railway Switch, E. F. Stone, Hyde Park, Mass., 497,061. Filed Feb. 1, 1890.

Adapts the switches and cars so that the switches may be moved and placed directly from the cars by the use of an electric current.

Telephones and Apparatus:—

Transfer System for Telephone Switchboards, E. A. Clark, Sioux City, Ia., 496,859. Filed June 24, 1892.

For transfers from one section of a switchboard to another or from one sub-office to another.

Multiple Switchboard Apparatus, C. E. Scribner, Chicago, Ill., 496.904. Filed Feb. 7, 1890.

For telephone exchanges. Relates to a listening, ringing and grounding key and to test circuits.

Multiple Switchboard System, C. E. Scribner, Chicago, Ill., 496,905. Filed March 1, 1890.

For telephone exchanges. Adapted to switchboards employing metallic circuits.

Multiple Switchboard Testing Apparatus, C. E. Scribner, Chicago, Ill., 496,906. Filed March 1, 1890.

For telephone exchanges. Especially adapted for metallic circuits.

Testing Apparatus for Multiple Switchboard Systems, C. E. Scribner, Chicago, Ill., 496,907. Filed March 24, 1890.

SOCIETY AND CLUB NOTES.

ANNUAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE annual meeting of the Institute begins in this city on May 16. We have already printed the programme. The following invitations have also been extended to the membership of the Institute. From Mr. Joseph Wetzler, president New York Electrical Society, to attend a lecture at Columbia College, Wednesday 8 p. m., May 17th, by Dr. Wm. J. Morton, entitled "A Glance at Electricity in Medicine," which promises to be of a most interesting character. New apparatus and experiments will be shown. Ladies are invited. From Dr. S. S. Wheeler, president Crocker-Wheeler Electric Company, to visit their new model factory at Ampere, N. J., where the entire plant is electrically driven. The 2.10 p. m. train of the D., L. & W. R. R., on Thursday, May 18th, which stops directly in front of the Works, has been fixed upon as the most convenient.

THE "BLUE-PRINT STEAL."

No further facts or statements of any importance have been brought out in regard to the alleged stealing of Westinghouse blue prints by the General Electric Company and its employees. All the defendants have waived the preliminary hearing and given bail for trial at court at Pittsburgh. The bill in equity filed at Salem, Mass., by the Westinghouse Company asking for the restitution of its stolen property, gives a list in minute detail of 180 blue prints alleged to have been in the possession of Messrs. E. W. Rice, Jr. and W. H. Knight, and by them used for the benefit of the General Company.

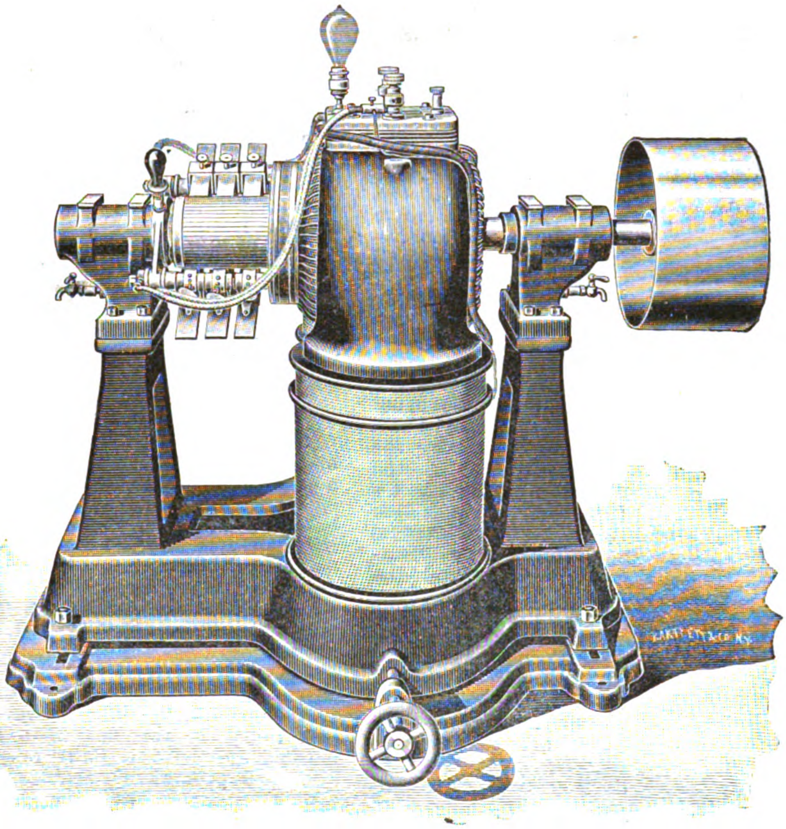
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW LA ROCHE DIRECT CURRENT DYNAMO.

The cut herewith represents the new type of direct current dynamo built by the well-known La Roche Electric Works of Philadelphia. This has been one of the most successful machines that has ever been turned out of their establishment, and for which they have received a number of duplicate orders, giving great satisfaction wherever placed.

The machine, as will be noticed, is of the motor type with Gramme ring armature of the latest improved construction, thereby reducing the speed very materially. It has all modern improvements with all parts interchangeable and made to gauge. The machine is compound wound and has been designed by Mr. F. A. La Roche. It is so constructed as to stand the most severe abuse that any machine of this kind can be subjected to. It has self-oiling bearings and automatic oil over-flow. The brush holders are of a new design and so made that any degree of tension can be secured, and so arranged that a free movement of the brushes around the commutator is allowed.



New La Roche Direct-Current Dynamo.

The commutator is made of specially hardened copper well insulated with mica. It will be noticed that the winding of the machine is peculiar, as any of the coils, either series or shunt, can be removed and new ones put in place without interfering with any other part of the machine. An extra heavy steel shaft is used thereby allowing no vibration and permitting the armature to run very close to the pole-pieces, consequently increasing the efficiency of the machine.

At a test of one of these machines it was shown that there was a variation of only $1\frac{8}{10}$ volts between no load and full load, which is a sufficiently close regulation for any purpose that a machine of this kind may be put to.

Within the last three months this Company has installed 15 of these machines in Philadelphia and vicinity, and they are spoken of in the highest terms.

The La Roche Company are now making arrangements for an increase in their manufacturing facilities.

Direct U. S. Cable Company.—For the greater convenience of patrons of the company, the Glasgow, Scotland, office has been established in more commodious quarters, at 4 Waterloo street, opposite the Corn Exchange.

ELECTRIC HEATING AT GREAT FALLS, MONT.

Mr. W. D. Dickinson, the superintendent of the Boston & Great Falls, Mont., Light & Power Company, and other interests there, informs us that electric heating is the subject of considerable interest and attention in that vicinity. At a recent exhibition of Carpenter electric heating apparatus, about 300 ladies and gentlemen visited the station during the afternoon, and displayed much curiosity and gratification. The current was furnished from the company's regular alternating incandescent 50-volt circuits. As a matter of fact, the company has been quietly introducing these utensils for more than a year, and has placed a great many in residences. The most popular article is the flat iron, and there are now more than 20 in use in different households.

THE ANSONIA ELECTRIC COMPANY.

The Ansonia Electric Company, formerly the Electrical Supply Company, have recently closed another nice contract in Iowa for Helios arc lamps to be used in street and commercial lighting. It has also secured a 30-ton order for their well-known P. & B.-line wire.

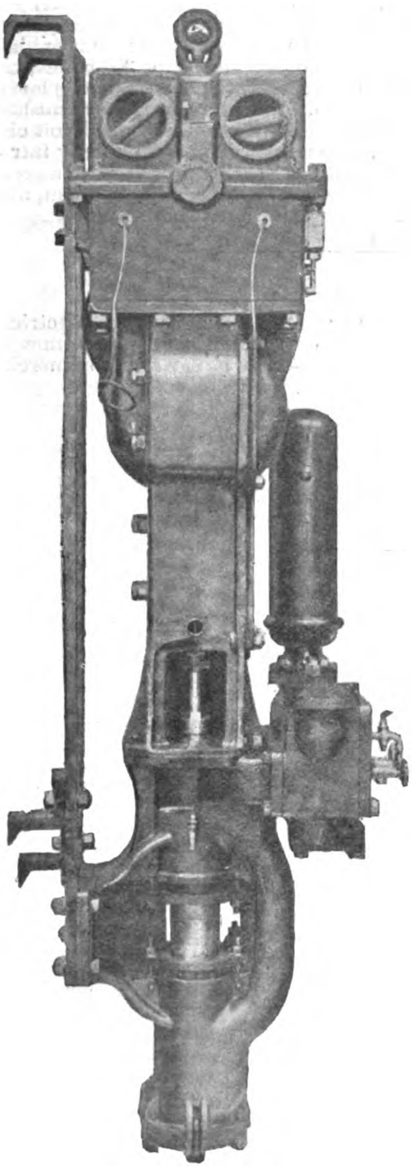
The "New Sunbeam" lamp handled by the Ansonia Electric Company, is taking as well as the old Sunbeam, judging from the number of orders reported.

WESTERN NOTES.

The Electric Appliance Company announce that the new Whitney voltmeters and ammeters for alternating current work are now ready for the market. They claim to have overcome the difficulty heretofore experienced with alternating instruments, caused by varying frequencies (which has made it necessary to calibrate each instrument to each machine on which it was to be used), and to have produced an instrument which can be placed on any circuit without a special recalibration, and give absolutely correct readings. This being the case, they undoubtedly have an instrument which has been long looked forward to for alternating current work and which will find an extensive field.

Mr. J. P. Malia, who for the past seven years has held the position of assistant electrician to Mr. A. Shillinglaw, recently resigned from the Armour Packing Company, will succeed him as chief electrician. Mr. Malia is a young man, a persistent student, and well able to fill his new position. This Company has many plants throughout the country, which come under the direct supervision of Mr. Malia. His appointment is well merited, and he has our congratulations.

GENERAL ELECTRIC CO.'S DUPLEX SINKING PUMP.



Duplex Mine Sinking Pump.

The accompanying engraving represents a view of the new mine sinking pump, built in various sizes by the General Electric Co., in which the main objects sought are, lightness, compactness, efficiency and non-liability to damage by water or hard usage. The motor with gearing and operating mechanism is entirely contained in a cast-steel casing, absolutely watertight. The pumps are of the duplex double-acting type, with outside packed plungers, and the only moving parts visible are short sections of the plungers and rods. All wearing parts are readily accessible for examination and can be quickly and easily replaced. The pump is not susceptible to damage from water, and its form is such that it will stand considerable hard usage, without injury. It will work as well under water as out of it, in fact, rather better, the cooling action of the water increasing the efficiency of the electric motor. If, therefore, the precaution is taken to use thoroughly insulated cables for conveying the electric energy to the pump, it may be "drowned" by a sudden rush of water in the mine and still continue operating. Even should the case leak slightly, the motor in the upper part of the case, within a waterproof chamber of its own and separated from the gearing, would remain long unaffected. There are no exposed working parts liable to damage, or to cause injury to those who may be working about the pump.

The new design is economical in the use of power and is claimed to have a very high efficiency. The pump illustrated has a capacity of 125 gallons per minute against a vertical head of 200 feet; it occupies a space of only 24 x 26 x 86 inches, and weighs, complete, 3,000 pounds.

THE SUCCESS OF H. WARD LEONARD & CO.

This company has met with a success in its peculiar line of "bulk electric contracting" which is astonishing in view of the general dullness in trade during the past year. The business of the company amounted to $530,000 during its first year, 1891-92, and its operations are increasing rapidly, both in this city and throughout the country. Since the first of January, the capital of the company has been doubled, the fully paid capital of the company now being $120,000. As this company has no agencies or affiliations with any manufacturing companies, and uses dynamos, engines and specialties made by all first-class makers, it has an exceptional familiarity with all apparatus and methods in the market, and can use them in its work to secure the best possible plant the state of the art will permit of.

Among the important contracts now being carried out by this company are the following: Cayadutta Electric Railway, bulk contract for complete railway, 17½ miles long, joining Gloversville, Johnstown and Fonda, New York State; Broadway Power House, bulk contract for steam and electric plant for 5,000 lights; Betz Building, Philadelphia, bulk contract for steam and electric plant for 4,000 lights; Broadway Cable Road, 50th street Power Station, bulk contract, steam and electric plant for 424 incandescent and 22 arc lights; Scott & Bowne Building, bulk electric contract for 1,500 lights; Cammeyer Building, 3,100 lights; Puck Building, 1,000 lights; New Netherlands Hotel, ventilating fans, motors, etc.; New York, New Haven & Hartford R.R. Building, 1,500 lights; Hawthorne Apartments, 300 lights; Home Life Insurance Company, 1,900 lights, dynamos and engines; Church Mission House, 900 lights; Johnson Building, wiring for 70 arc lamps; Princeton Inn, tubing for 232 outlets; Decker Building, 1,200 lights.

THE CASE AUTOMATIC HIGH SPEED ENGINE.

The J. T. Case Engine Company, of New Britain, Conn, have issued another very tasteful catalogue and pamphlet relative to their automatic engines. This little engine is so handy, and so ingeniously constructed that it admits of a greater range of application than any other steam motor. In fact it resembles an electric motor in its general availability, and may be seen in all sorts of awkward places doing all kinds of difficult work. This pamphlet, which is from the well-known art press of Bartlett & Company, shows the engine complete and in detail, and illustrates its use when fastened to walls or ceilings, as well as in more ordinary situations. A list is given of the various dimensions of pedestal and bracket Case engines. The officers of the company are: P. Corbin, president; M. C. Swift, secretary; F. G. Platt, treasurer, and W. S. Hine, general sales manager.

"CANVAS JACKET" IN THE WEST.

Mr. A. Shillinglaw, who for the past 13 years has had entire charge of everything pertaining to electricity for the large packing concern of Armour & Company, has resigned his position with that firm to accept the western agency of the American Circular Loom Company, and has associated himself with Mr. C. E. Woodruff and Mr. Jno. F. Figel, both well-known to the electrical trade. The firm name will be C. E. Woodruff & Company. They have an excellent location and store at 235 Lake street, Chicago. The firm will handle as well, a full line of leather and rubber belting, hose, packing, &c. The Engineer bespeaks a liberal patronage for the young house.

ST. LOUIS NOTES.

The American Electric Manufacturing Co., of St. Louis, makers of the American incandescent lamp, have resumed the manufacture of this well-known lamp. The factory has been closed for some months during which time great improvements have been made in their works. New and first class lamp making apparatus, with all the improvements incident to the manufacture of high grade incandescent lamps, has been installed, doubling the capacity. The American lamp was perhaps not as widely known as others from the fact that the facilities of the factory were somewhat limited, and the orders at all times outran the capacity. The lamp giving excellent satisfaction and the company's business being mostly local, they did not reach out much for outside business as they could not handle it. With their increased facilities, however, the American Company are now fairly in the field with an excellent lamp, for an open market and with a daily output equal to a largely increased trade with prompt shipments.

PHILADELPHIA NOTES.

Mr. G. A. Wilbur, Philadelphia representative of the Fort Wayne Electric Company, has placed four more Wood arc light dynamos of 60 lights each in the Southern Electric Light and Power Company's plant, which in addition to their present plant gives them a capacity of 840 arc lights. Mr. Wilbur has also sold the Wilmington City Electric Company a 60 Wood arc light plant.

Partrick & Carter Company are meeting with great success with their "Automatic Setback Annunciator." These annunciators have become a standard article and are kept in stock by most of the large dealers throughout the country.

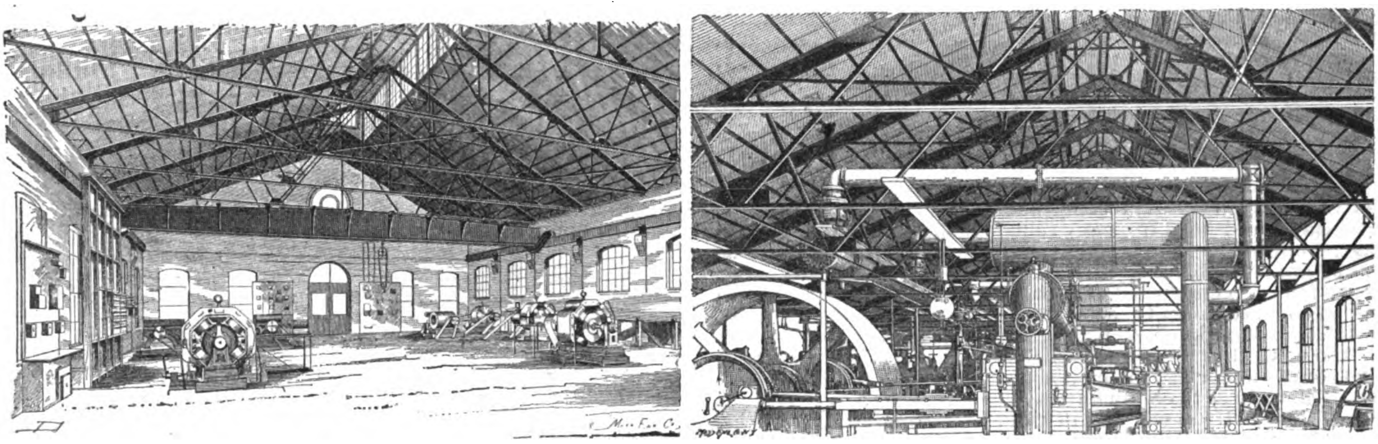
WESTERN NOTES.

The Ansonia Electric Company, are having excellent success with their new street railway appliances for overhead construction. The new material is guaranteed both for strength and insulation, and has received the endorsement of railway experts. The Ansonia Electric Company have added to their list of contracts for overhead equipment, the road 13 miles in length, running between Goshen and Elkhart, Ind.

The Nutting Electric Manufacturing Company, whose factory was recently destroyed by fire, have secured new quarters at 128 and 130 South Clinton street, Chicago, where they will continue to manufacture the well-known Nutting arc lamps. Facilities have been increased and these lamps will hereafter be manufactured extensively.

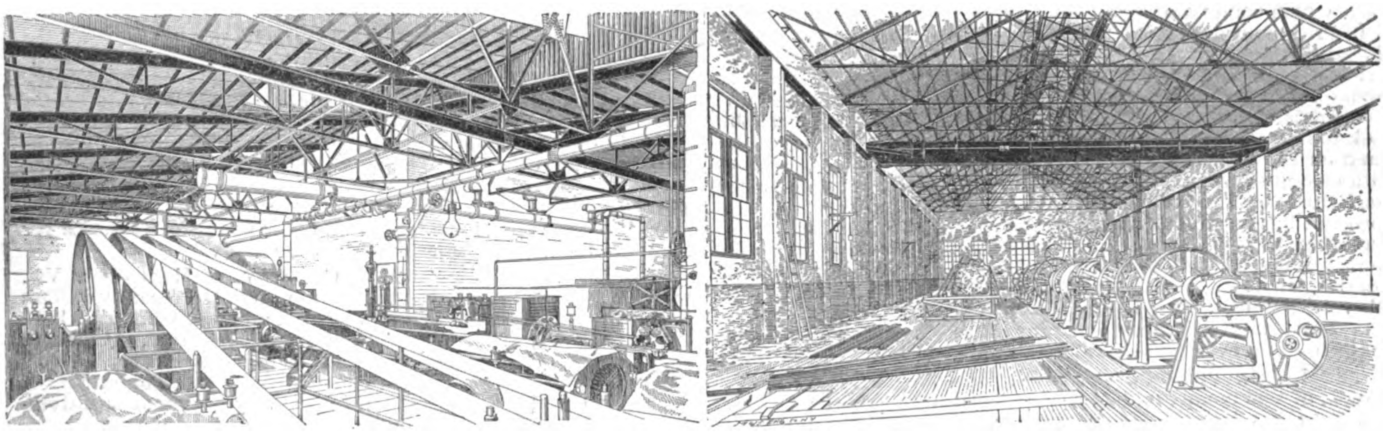
CENTRAL STATIONS AT PAWTUCKET, WASHINGTON, PROVIDENCE AND ELMIRA.

THE designing and building of power stations not only for electric lighting, but for all classes of buildings where electric power is developed is assuming very important proportions. In the case of an electric light company or an electric street railway company, if the power stops, the revenue stops. Fire not only destroys property, but it shuts off absolutely all sources of revenue, so that it is of the utmost importance that these power stations should be built as nearly fireproof as it is possible. Time has demonstrated that no building is absolutely fireproof when surrounded by buildings of a combustible construction or when filled with combustible material. Generally speaking, power stations are located so as not to be surrounded by buildings of a combustible construction, and there is no earthly need for any combustible material to be stored in them. Under these circumstances, the construction of a station which is fireproof in every way is not impossible. Indeed, we are able to illustrate on this page four stations which are absolutely fireproof for the reason that there is no woodwork about the buildings to take fire. Among the pioneers in this class of construction is The Berlin Iron Bridge Co., of East Berlin, Conn., and to them we are indebted for the illustrations which we here produce.



FIGS. 1 AND 2.—CENTRAL STATION ROOFS AT PAWTUCKET, R. I. AND PROVIDENCE, R. I.

Fig. 1 is an interior view of the dynamo room of the Pawtucket Gas Co., at Pawtucket, R. I. The Berlin Iron Bridge Co. designed and built the roofs on the entire plant for the Pawtucket Gas Co. and this illustration serves to show the construction of the roofs over the engine and boiler rooms of the same plant as well as the dynamo-room roof. The dynamo-room roof is 60 feet in width and is 150 feet in length. The side walls are of brick, the roof being of iron covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron roofing. The construction is particularly adapted for dynamo-rooms for the reason that while being absolutely fireproof, the corrugated iron is so protected that no moisture will condense on the under side in all changes of temperature, or in the most severe winter weather. The first roof of any importance upon which the Berlin Company used this construction was the Narragansett Electric Lighting Co.'s, at dence, R. I. This station has been built some five years, and during that time not a drop of water, it is said, has ever condensed on the underside of the corrugated iron.



FIGS. 3 AND 4.—CENTRAL STATION ROOFS AT WASHINGTON, D. C. AND ELMIRA, N. Y.

Fig. 2 is an interior view in the engine-room of the Narragansett Electric Lighting Co., at Providence, R. I. This engine-room is 67 feet in width and 200 feet in length, the side walls being of brick, and the roof of iron covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron roof covering. The Narragansett Electric Lighting Company's plant at Providence, R. I., was designed by the well-known electrical engineers, Remington & Henthorn. All the roofs on this plant were furnished by the Berlin Company and are of the same pattern as that shown in the above illustration, which is taken direct from a photograph of the interior of the engine-room.

Fig. 3 is an interior view in the dynamo room of the United States Electric Lighting Company, at Washington, D. C., and shows an iron roof which is of the same general construction as that noted and described above for the Pawtucket and Providence stations. The covering is the same patent anti-condensation corrugated iron, and although the roof has been in use some four years now, no trouble whatever has been experienced from any moisture dripping from the underside of the corrugated iron roof.

Fig. 4 is an interior view in the dynamo room of the Elmira Illuminating Company, at Elmira, N. Y. This plant is similar in construction to other plants above described, all the buildings being of brick and all the roofs being covered with the Berlin Bridge Company's patent anti-condensation corrugated iron supported by iron roof trusses and iron purlins.

These buildings as noted, are covered with corrugated iron, and are absolutely fire-proof for the reason that there is nothing about the construction to take fire. Heretofore, the great trouble with corrugated iron has been on account of condensation on the underside during cold weather, and many companies have been led into using corrugated iron on account of its fire-proof qualities, only to find that in cold weather the damage from water dripping from the underside of the roof was even worse than the damage from fire. There was an extended discussion of the subject early last year in THE ELECTRICAL ENGINEER. The Berlin Iron Bridge Company, of East Berlin, Conn., seem to have successfully solved this problem in the methods adopted and referred to above.

ELECTRICITY AT THE PRESS CLUB FAIR.

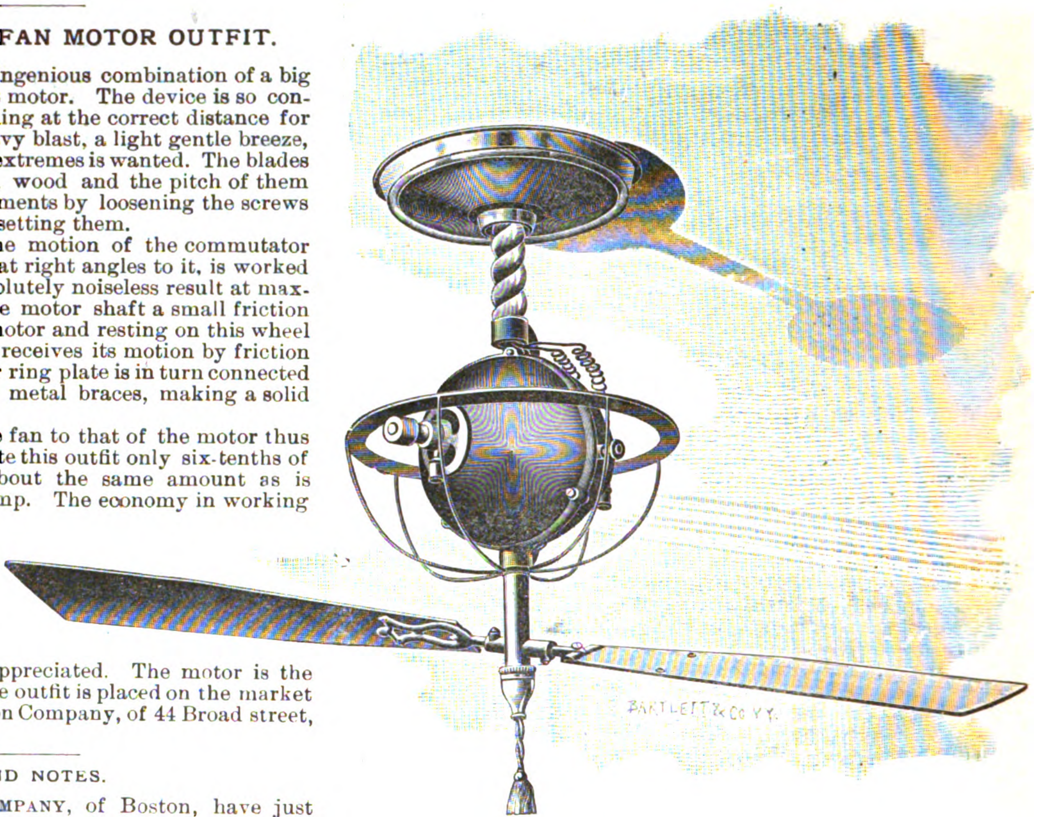
The Press Club Fair, now being held at the Grand Central Palace, in this city, has been the recipient of some generous donations from the electrical fraternity. The Edison Electric Illuminating Company built and furnished the current for the electric tower in the centre of the main hall, which forms such a conspicuous part of the decorative effects. A set of Long Distance instruments has been installed by the Long Distance Telephone Company, and during the evening hours the public, for a small fee, which goes to the treasury of the Press Club, can hear music played at Chicago and talk over the line. It is proposed to have the bands at the World's Fair placed in telephonic communication when the exhibit in Electricity Building at Chicago is completed. The Gray telautograph forms a part of the industrial exhibit, and, from the crowds seen around the booth in which it is placed, is apparently the most interesting thing in this department.

THE LUNDELL CEILING FAN MOTOR OUTFIT.

We illustrate on this page an ingenious combination of a big two blade fan and a small compact motor. The device is so constructed as to depend from any ceiling at the correct distance for the required effect, whether a heavy blast, a light gentle breeze, or any gradation between the two extremes is wanted. The blades of the fan are constructed of hard wood and the pitch of them can be changed to suit the requirements by loosening the screws which hold them in position and resetting them.

The method of transforming the motion of the commutator shaft of the motor into a motion at right angles to it, is worked out so cleverly as to obtain an absolutely noiseless result at maximum speed. Upon one end of the motor shaft a small friction wheel is attached. Encircling the motor and resting on this wheel is a thin circular ring plate which receives its motion by friction from the small wheel. This circular ring plate is in turn connected with the fan shaft by four curved metal braces, making a solid and strong construction.

The relation of the speed of the fan to that of the motor thus becomes as one to eight. To operate this outfit only six-tenths of an ampere is required or just about the same amount as is required for an ordinary 16 c. p. lamp. The economy in working this outfit, therefore, is readily appreciated. The motor is the invention of Robert Lundell and the outfit is placed on the market by the Interior Conduit & Insulation Company, of 44 Broad street, New York City.


BARTLETT & CO N.Y.

Lundell Ceiling Fan Motor Outfit.

NEW ENGLAND NOTES.

The Pettingell-Andrews Company, of Boston, have just sent out to their numerous friends a new and extremely handsome and complete catalogue of all the goods which they handle. The book, which comprises some 200 pages, has been compiled by Mr. C. B. Price, with his usual care, and reflects great credit upon his good taste and business thoroughness. Naturally Okonite forms the leading feature, the Pettingell-Andrews Company having for many years held the exclusive agency of this wire in New England, and one has but to glance at the back cover of the book to find out how important a position in this Company's estimation the well-known Okonite holds. The book commences with Okonite and it ends with Okonite, and the Okonite trade mark fairly bristles all over the inside. Everything else is there, however, but to enumerate would be to publish the catalogue. Tools, brackets, batteries, cables, cut-outs, cleats, fuse-wire, insulators, interior conduit, lamps, motors of all kinds, rubber tubing, rosettes, switches, sockets, tapes, wires, etc., etc., follow each other in regular order; in fact, everything that a central station man could want may be found in this handsome edition which ought to be on every superintendent's desk.

The Brown Electric Company, Boston.—Mr. Maybin W. Brown, of this company, has just returned from Lancaster, Pa., where he has closed a contract for a twelve mile equipment for the Lancaster and Columbia Railway Company, who are now engaged in installing a single track electric railway between the two cities. No switches will be used on the road at the turn-outs, but a double trolley wire will be suspended over the single track along its whole length, about eight inches apart, so that the danger of the trolley wheel flying off at switches will be entirely avoided. A special form of double insulator furnished by the Brown Electric Company, for the suspension of the double trolley wire, will be used, and it is expected that a speed of 35 miles an hour will be attained, making it the fastest electric railway in the country. Mr. Brown has also secured the overhead equipment for the extension of the Hartford and Wethersfield railroad at Hartford, Conn.

Claflin & Kimball, of Boston, are the recipients of many hearty congratulations upon the success of their new "Novak" lamp, which in most cases take the form of handsome orders in quantities from barrel lots to lots of 5,000. They are now selling about 2,000 lamps a day and are almost snowed under with orders, but are straining every nerve to increase the capacity of the factory of the Waring Electric Company, and will, within the next few days, be able to take care of at least 4,000 lamps a day. From all reports the "Novak" has proved successful, and the sneers of the unbelievers are rapidly being squelched. The "Novak" has filled the conventional "long felt want," and being the first new lamp in the field in the East, is selling like the proverbial "hot cakes." Claflin & Kimball are to be congratulated upon their enterprise, and every lamp consumer in the country ought to have some "Novaks" on his circuit, to show his appreciation of their efforts. Afterwards they buy them because they like them.

The Eastern Electric Cable Company, of Boston, continue right along to run night and day, turning out mile after mile of the favorite Clark wire, in every conceivable style and size. They have just added two more large stranding machines, and are at present engaged handling some very heavy telephone and telegraph cables. In their new factory, one would hardly recognize the comparatively small factory which stood in the same place some three years ago. Necessity for more room has forced them to add story after story and new building after new building, until now they have one of the largest and best equipped factories for the manufacture of insulated wire in the East.

The L. P. & D. Transmitter Company, of Montpelier, Vt., whose new forms of transmitters were illustrated recently in The Electrical Engineer have just secured an order from Mr. C. F. Foster, engineer of the World's Columbian Exposition, at Chicago, for two of their most recent transmitters to be used at the World's Fair, where they will be seen to good advantage. This system of transmitting power is gaining in favor every day, and is universally giving entire satisfaction.

Mr. Frank S. De Ronde, the well-known general sales agent of the Standard Paint Company, of New York, paid a flying visit to a number of his friends in Boston, this week, and was fortunate enough to carry back with him orders for about a dozen car loads of P. & B. paint, which he picked up in his usual happy way from a number of his electrical customers and others.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XV. MAY 24, 1893. No. 264.

ELECTRICAL THEORY.

BY

Albert L. Arnet

THE study of electricity has been made difficult in the past because for the most part our teachers have thought it necessary to give the subject a special method of treatment. This necessity arose from the fact that electrical phenomena were set aside in a class by themselves; they were thought to be phenomena of an entirely different order from those usually dealt with, and hence deserving of special treatment. If there were some who did not so classify them, they, at least, considered a special treatment to be the only practical course till in the progress of knowledge we should arrive at a better conception of the laws governing electromagnetic action and the relation subsisting between it and phenomena of the more common kind.

To say that electromagnetic phenomena were put in a class by themselves is to say that, in some sense, they were compelled to remain unclassified. To study them was to explore in the dark. When knowledge was wanting and words must be had, action at a distance was called in and made to play the part of working hypothesis. Action at a distance still plays its rôle. Men not only use it, but believe in it; and it is to be seriously doubted, if, in the higher regions of physical science our teachers even as yet rise to a fair conception of the part played by the electromagnetic medium.

However this may be, its cause lies not so much in the teacher as in the general imperfection and incompleteness of our knowledge in this part of the domain of physical science. The past decade has witnessed a wonderful accumulation of experimental data, the interpretation of which remains as yet largely to be done. In the present condition of things it is not too much to say that the average electrical student finds that reading modern electrical theory operates very much like the spider's web upon the fly—the consummation of a hopeless tangle. Progress is being made, however, along certain definite lines; and it is with hope inspired with confidence in the possibilities of the future that we believe there will yet be born that genius for electrical theory who will be able to communicate with ordinary intelligence and receive the unqualified assurance that the latter has received the communication. Electrical language is burdened with circumlocution and vagueness revealing dimly things clearly seen.

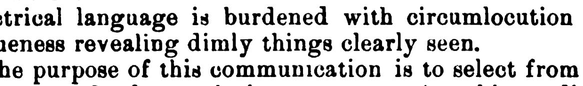


FIG. 1.

The purpose of this communication is to select from the modern textbook a typical case representing this condition of things, and to show, if possible, why the development took the form it did; and while not attempting any reconstruction of theory it will endeavor to point out what appears to the writer the direction that progress in theory should take.

The case we have selected for this purpose is that of a current induced in a circuit B by the making or breaking of a neighboring circuit A, Fig. 1.

Lenz's law states that at the moment of closing K the current in A sets up an inverse current in B, and on opening K the direction of the latter is reversed. Or, to put it in the words of many recent writers, in all cases of induced currents their direction is such as tends to destroy the current which set them up.

While the law does not purport to be an account of the phenomenon, it is true that it constitutes about all that is taught in the common text-book concerning induced currents. The student asks for an explanation. To tell him that we observe certain things here and certain other things there will not suffice. What he wants is an account of this phenomenon such as relates it to other well-known phenomena. A branch of the tree of science removed from the trunk altogether, he has no use for. In short, an explanation that explains is in order. Are we told that Faraday understood it? It fails to console him. The mantle of Faraday did not fall on him. The electromagnetic medium and the idea of lines of force are good enough food for him but he would much prefer them cooked. To cook them a Faraday only is competent. Doubtless we have many men of science to-day who see their way clearly in this problem and who are doing themselves honor in clearing the way for their students. But why do we progress so slowly? Must it be confessed that of all problems, electricity presents the most difficult, and that to understand them one must spend years in study? I do not think we are driven to such a conclusion. Did we but approach the electrical problem from the same side that we do other problems of like kind the chief element of discord would be removed. Whether this can be done remains to be ascertained. How radically different are our methods of operating upon two similar problems, will now be considered.

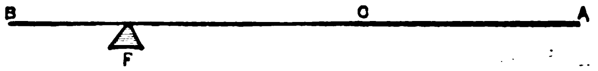


FIG. 2.

Referring again to Fig. 1, we are told that certain currents manifest themselves as before described; in fact, all explanations of electrical phenomena base themselves fundamentally upon the idea of an electric current. The electric current has for its foundation the same sort of stuff that Atlas stands on. Instead of giving all our attention to these so-called currents let us notice that we have here so arranged the parts of a simple mechanism that by it we are enabled to transfer energy from one point of space to another. By even so simple a device as a battery and these two circuits we can send the energy of chemical union at a point A to a distant point B and there it will do work for us, either by turning a magnetic needle or affording us a quantity of light and heat.

The idea suggests itself here that we have to all intents and purposes, a *machine*. If this conclusion be right, it remains to determine of what mechanical powers it is composed, and if the operation of these latter be known the electrical action in question is explained. Essentially, the problem is one of transfer of energy and as such should ally itself closely with problems in mechanics. A machine of great simplicity whose essential nature makes it a transferer of energy, is the lever. Granting that we have here two cases essentially the same, let us inquire what we know about the lever and the method by which we obtain our knowledge.

Fig. 2 is a lever of the first kind.

By this simple machine we are enabled to transfer energy from point A to point B. We measure the energy put into the system at A thus: a force f acts at A, displacing A through a distance d, doing $f\,d$ foot pounds of work. At B there reappears a quantity of work manifesting itself similarly by a force f' acting through a distance d', equivalent to $f'\,d'$ foot pounds. We find that $f'\,d'$ is less than $f\,d$ and that the ratio $\frac{f'\,d'}{f\,d}$ measures the efficiency of the lever. We learn that the transmission involves a loss of energy, a loss occasioned by the friction of the machine. That part of the phenomenon, that vital process by which energy passes along the bar from A to B does not concern us very much. We believe that this lost energy becomes converted into heat in the parts of the bar and we let it go at that.

Now when we come to the electrical problem, why should we not proceed in the same way. Returning to Fig. 1, let us measure the energy put into the system at A, and also that which appears in the shape of mechanical work in B; the consumption of zinc in the battery goes on at a definite rate and yields an accurate measure of the energy expended and is equivalent to a certain number of foot pounds. The mechanical work appearing in B rotating a magnet is likewise to be computed in foot pounds. The difference between these two quantities is the loss in transmission. Such a method of procedure would render us independent of any theory of currents.

In the case of the lever, the energy consumed as friction is very small; while the mechanical energy expended and that utilized being relatively large they stand out prominently, and consequently receive the greater share of attention. A lever in operation, but lifting no load, is analogous to our case in Fig. 1, when no mechanical work is performed at B. In mechanics, we are not accustomed to study such cases much; in electricity, sad to relate, we have studied them too much. To concentrate our attention on electric currents is comparable in our mechanical problem only to the prying into the mysteries associated with stress and strain in the lever bar. In much of our electrical work little mechanical work is utilized; a bell may ring, or a telegraph key may click, but the major part of the impressed energy is spent as a friction loss. Thus it is that the phenomenon of a current has been made to receive the most attention. As compared to a lever, transmission of energy by electricity is a much inferior means for short distances; for long distances electricity is the more efficient. Had the immortal Faraday and his colaborers seen the spectacle of men working with levers a mile long, the theory of the lever would undoubtedly have dealt more with stress and strain than it has. Electrical currents would then have had their counterpart in mechanics, and electrical theory might have developed on a more rational basis.

VIBRATION OF WIRE UNDER CURRENT STRESS.

At the recent exhibition of the Société Française de Physique, M. Hurmuzescu showed the following experiment:—A metallic wire, through which a continuous current is passed, is stretched horizontally in a glass tube containing gas either at the ordinary atmospheric pressure or rarefied. As soon as the wire becomes red-hot it begins to vibrate in a vertical plane, and the containing tube becomes much hotter at the bottom than at the sides. This effect has not been satisfactorily explained by its discoverer.

THE IDEAL ELECTRIC METER.

BY

H. G. Stratton

The object of this paper is not so much to give a detailed account of the construction of meters, that being most admirably done by Mr. Haskins in his recent paper before the American Institute of Electrical Engineers, as to take up, in a general way, the requirements of an ideal electric meter and the errors that may arise in the operation of the different forms of meters.

Let us look into the requirements of a meter. First of all, it should be a wattmeter instead of a recording ammeter. Owing to the rapid and extended increase of electricity in a commercial form, people are becoming more familiar every day with its fundamental principles and the day is past, let us hope, when they will have to be argued into understanding the fact that a simple recording ammeter will not take care of all the variations of load, especially for motor use.

The next important point is to have a direct reading meter, one that a consumer can read himself, if so desired. This point will be especially appreciated by managers of electric light companies.

The third point is to have a meter of comparatively small initial cost and simple, both in construction and operation. One that can be easily installed and looked after; and one which can be verified by local companies without much loss of time and money.

There are practically three forms of meters on the market to-day; namely, the motor type, the magnetic-clock combination and the chemical. Let us examine each type separately and see wherein their defects lie.

Of course it is a well-known fact that the most accurate calibration of electric currents can be effected by means of electrolysis. Now a meter on this principle is all very well for laboratory use, but it requires such extraordinary care to get good results out of it that I have very grave doubts whether, or not, it is commercially a success and wholly within the lines of practicability. There are so many things that one is obliged to contend with in the operation of a chemical meter, together with the great relative expense, that it seems hardly a meter for every-day men to operate; besides it has the objectionable point of not being direct reading.

Let us look into the manner of operating this meter and see if the above statements are not true First of all, a workshop especially set apart for the preparation of plates, is one of the essential requirements; then a small room for weighing the plates is also required, all of which take time and money. The work to be done in preparing plates for changing can be divided into several stages: First the grinding or cleaning of the zincs preparatory to amalgamation, which is the second stage. This is followed by weighing the plates before going out, after which they are paired off and bottled. After substituting the new bottle for those outstanding, the outstanding plates are taken apart and, oxidation being eliminated, they are weighed.

Take a station operating, say, five to six hundred meters; it would require three boys, of from sixteen to twenty years of age, to devote their whole time to this work, whereas if a direct reading, mechanical meter was employed, one boy could do the whole work in about one week a month and be put on other work to fill up. Then again, there are so many renewals in this type of meter that quite a large amount must be added to the expense account on this score.

Let us go still deeper into this meter and see some of the errors that are liable to occur. The most important point in the operation of this type of meter is having the chemical solution of the right specific gravity. To get this requires great care; something which you will not always get from the ordinary workman on small pay. Then again, suppose at the meter room the specific gravity is all right, but that the temperature is way down below freezing and that upon conveying the bottles to their respective meters, they become chilled to such an extent that the temperature of the liquid is such that it is way below what it should be to be compensated for at once by the compensating spool. Before it has reached that point where the compensator will take care of variation in temperature, a considerable amount of current has been consumed by the customer and improperly registered, the company being the loser. The writer has had this very thing happen. The advocate of the chemical meter might say that this can be obviated with care; I admit that it might be to a certain extent, but still it is liable to occur.

Again, the bottles may become cracked or broken, thus allowing the solution to run out, so that the plates are not entirely covered, thus increasing the resistance of the bottle circuit and making a lower reading than it should be. Evaporation may also take place with the same results as above. Besides all this, oxidation may not be entirely eliminated, thus causing either too high or too low readings. Mistakes may be made in weighing, but this is not liable to occur where the system of check weighing is used, as it is by a number of companies. Besides all this tale of woe, there is still another objectionable feature which must be added, that is, that the chemical meter cannot be operated on alternating currents. So much for the chemical meter. Now let us look into the other two types cited above.

In any form of wattmeter, there is more or less waste of energy due to the closed circuit maintained between the lead wires. This can be done away with when the meter is not in use, by some arrangement for automatically opening the circuit, and when it is thrown in circuit, by the passing of a current, used by the consumer, it is registered against him; but it is so small, that it does not count for much, whereas if it were thrown against the company it would amount to considerable, where several hundred meters were in use. Then again this motor type has another disadvantage in its liability to be burnt out by lightning. This is quite an objectionable feature inasmuch as the man in charge of the meters is never sure that they are in working order and must inspect them after each thunderstorm.

Still another point of disadvantage is that of not being able, in the construction of the meter, to get rotation varying exactly with the square of the current, or in the direct ratio, and therefore being obliged to introduce some other means to help this out, such as adding friction, etc. While this may do for calibration, friction is a variable quantity, and before long it is not performing its function as it should and the meter is either too fast, or too slow, as the case may be. This type of meter, as well as the magnetic clock combination, has the advantage in being direct reading, a wattmeter and of very little expense to operate.

While some motor meters are capable of being operated on either direct or alternating currents, yet others are only capable of operating either one or the other, but not both, which is a disadvantage. There are several meters of the last type, namely, magnetic clock combinations, but none of them as yet entirely fill the bill. Take for instance one type, which has a revolving disc with pegs arranged around its periphery, each peg representing a lamp; the range of registration is too great between two lamps to make a successful meter; besides, it is only a recording ammeter; still it could be made a wattmeter without much additional cost. These meters are objectionable inasmuch as they are not accurate on alternating currents.

The true, practical meter should be on the electric clock arrangement for several reasons. First, the registering part is operated by clockwork and therefore does not require electrical energy to run it. Second, it can be arranged so that should lightning strike it and burn out the high resistance connection between the opposite poles, it would still register the greater part of the energy by the passage of the current being used. It should be accurate on both direct and alternating currents, simple in design and capable of withstanding considerable hard usage.

SINGLE PHASE ALTERNATING MOTORS.

BY

Wm A. Turbayne.

On account of the discussions which have recently taken place regarding alternating current motors of various types, it might be well to illustrate a form of motor designed by the writer early this spring, and which is in constant use operating an organ bellows in a Lutheran Methodist Church, at Detroit, Mich. This motor was manufactured from the writer's designs by Messrs. W. Hurd and Liggett, who also contracted to supply the same after having been told that it could not be operated successfully, being the first and only installation of this type of motor in the city mentioned, for other power purposes than the ordinary rotating fan.

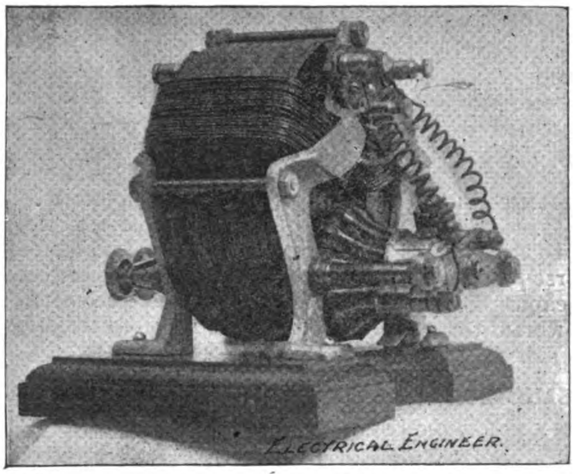


FIG. 1.—TURBAYNE SINGLE PHASE ALTERNATING MOTOR.

The engraving, Fig. 1, made from a photograph, plainly indicates the form and general construction of the motor. The iron work is massive and but little wire is used in the windings; a smooth wound drum armature is also used.

Although for alternating motors the iron-clad form of magnet is undoubtedly the best, yet this individual motor was designed in order that standard circular dies could be used in punching out the laminations. Fig. 2 illustrates this method, showing a single field lamination. Ordinary armature discs of proper size were taken and a hole was punched as shown, forming the opening for the armature, and made in such a way that the upper and lower polar projections would be equidistant. When completed this makes a fairly efficient alternating electromagnet. Two field coils are used, disposed in such a manner near the poles as to get the best results.

No metal is placed in such magnetic relation as would induce currents therein, and decreasing the efficiency by forming closed secondaries. The two brass castings which serve to clamp the whole together, also act as standards for the motor and armature bearings, and to a certain extent protect the fields. On account of the large cross-section of iron and low saturation, losses by hysteresis must be small as would also eddy losses, the laminations being carefully insulated with paper; in fact, after a constant run of two hours the iron was but slightly warmed.

This motor was designed as a series machine to operate on a constant load, but before delivering, it was experimented upon in various ways. When connected in series it started off with vigorous torque, the maximum field and armature magnetization being, of course, closely related, and in this respect being very analagous to a direct current motor. It was also tried as an induction motor, the fields being connected directly to the source of current and the armature short-circuited by connecting a wire across the brushes. It then ran at a constant speed of about 1,800 revolutions per minute, which speed it tended to maintain against fairly heavy loads. The starting effort was, of course, not so great, and the magnetizing current was necessarily larger, being increased by the greater gaps formed in using a smoothly wound drum armature.

Being pressed for time, the writer did not make any tests as to the efficiency of the motor. It is about one-fifth horse-power, and being designed more particularly for cheapness of construction, it certainly proved to be more powerful than interested parties expected.

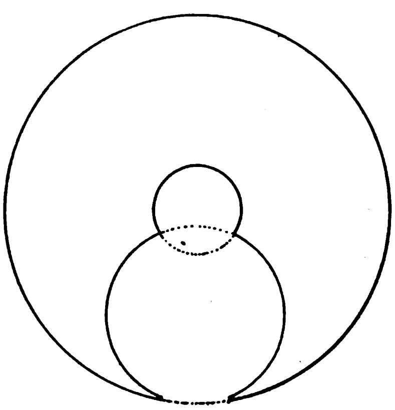


FIG. 2.—TURBAYNE SINGLE PHASE MOTOR.

REMINISCENCES OF EARLY TELEPHONE DAYS.—II.

BY

F. E. Kinsman.

(*Concluded*).

As stated last week, I gave up my employment in 1877, believing the plan would be carried out; and I had devoted my entire time and work to the project of applying the telephone to daily needs. Some of my friends to whom I resorted for advice, tried to console me by saying: "As for the telephone, no one knows whether it will amount to anything or not." After some futile efforts to secure assistance in prosecuting what I believed to be my just claims, I left Boston, about the middle of June, 1877, for my boyhood's home on my father's farm. Vivid still is my remembrance of the expressions of sympathy for my disappointment on the part of friends and neighbors, coupled with more or less compassionate remarks regarding my credulity and infatuation with the subject. In the view of many of these kind friends I was doubtless another of the unfortunate and incorrigible inventors upon whom sympathy was practically wasted.

Early in September, 1877, I was surprised by the receipt of a letter from E. T. Holmes of Boston requesting me to enter his service at the munificent salary of $10 per week, to assist in the introduction of the telephone in that city. The letter stated that he had been led to make this offer in view of the fact that he had learned of my experience in planning the central office system, and believed that this experience would be of some value to him. Unable to do better I accepted his terms and went to Boston, and in company with another of his employés there, constructed what I believe to have been the first "central office" telephone system ever built. When, as before stated, I disclosed my plans to Mr. Hubbard, I was, as I believe, the first inventor of such a system, and if I had known what I know now of the patent law I should have been able to support my claim to the credit and benefits of such an invention. During my experience of about two months and a half with Mr. Holmes, who had (as I afterwards learned) undertaken the introduction of the telephone in Boston at Mr. Hubbard's solicitation, I became acquainted with Professor Dolbear and with persons interested in his telephone work. Among them was Mr. Lee of the well-known publishing house of Lee & Shepard. Mr. Lee gave me a letter of introduction to the late Hon. George Walker, then president of the Gold & Stock Telegraph Company of New York. Securing leave of absence, I visited Mr. Walker, who, upon learning of my experience and knowledge of the telephone business engaged me to come to New York for the purpose of having me here during the organization and preliminary work of the American Speaking Telephone Company. That company was about to introduce the telephone inventions of Mr. Edison and others. During the time I spent with him an incident occurred illustrating the comparatively narrow view of the future of the telephone business then prevailing among those most interested in its success. For some time it had been my custom to go to Mr. Walker's office in the morning of such days as a meeting of the incorporators of the American Speaking Telephone Co. was to be held, and to suggest to Mr. Walker anything that I thought would be of interest relative to the methods to be pursued, and afterwards to appear before the board to give such information and answer such of their questions as my experience enabled me to do. In the instance I refer to, I said to Mr. Walker that "it would be necessary for each subscriber for telephone service to have a line between the subscriber's place of business and the telephone central office station." The idea appeared to Mr. Walker so ridiculous that he indulged in a hearty laugh at my expense; then assuming a more serious mood he said: "Why, Mr. Kinsman, how much do you suppose it would cost this company to build a line to each of the subscribers they expect to get?" I answered that I could not tell what it would cost in New York, but that he would find that, no matter how much it cost, it would be the only means of securing satisfactory results. He said that he differed with me, and requested me to say nothing about it in the next meeting, as the great cost would make the undertaking questionable and that he did not wish the subject discussed, as he saw no reason for assuming such a position. After the company was organized I was sent by Mr. Walker to Chicago to assist the American District Telegraph Company in establishing their Chicago telephone business, under the auspices of the Western Union Telegraph Company. Upon arrival there, finding that they were not prepared to proceed with the work, I secured employment in the Western Electric Company's factory. After some months the American District Telegraph Company notified me that they were ready. Then began an experience which I shall never forget. The telephone had never been used in Chicago for more than exhibition purposes, and I found business men very incredulous both as to its practicability and as to the number of subscribers likely to be obtained. I soon abandoned an attempt to secure a general line of customers and took up the banks by themselves. Mr. George Sturgiss, president of the North Western National Bank was the first subscriber; Mr. Nash of the Illinois Central National Bank was the second. Their subscriptions, however, were given upon the condition that I should secure the subscriptions of all the banks in the city. This was soon accomplished and my attention was next given to the railroad companies, all of whom were in due time added to the list upon similar conditions. Then came the lumbermen, after which the work of securing a general list of subscribers was comparatively easy.

The practical features of the business were quite as difficult to get under way as the securing of patrons. Well do I remember the herculean efforts of "Nick" Rossou in carrying on the outside construction work. Many a time I have seen his genial face clouded by disappointment at the failure of some line to perform its duties properly after he had spent days in getting it into position. He knew the line was O. K. and the operators knew it wasn't; somehow there were more "bugs" in a telephone line than in a district telegraph line. The central office was another point of great interest, but seemed to lack the conditions to make it a place of joy forever. The first switchboard was a 12-line Western Union strap switchboard, and its operation was regarded with awe by the employés in the district telegraph part of the business. I believe it was here that the district telegraph boxes were first regularly used to signal for a communication on the telephone line, *the call boxes and telephones being on separate circuits.* The number of calls per diem was at that time of more absorbing interest than now-a-days, although the number now is probably many thousands to each one of that time. We soon outgrew the 12-line board and a larger one of the same character was put up. This soon became inadequate and then came the most serious question ever presented to a central office manager, namely, that of providing a switchboard large enough to accommodate the very rapidly increasing business. Messenger boys were used for operators, and the state of affairs existing in the central office can never be adequately described. Pandemonium reigned, and the largest boy generally answered most calls. The destruction of flexible cord made glad the hearts of the wire manufacturers.

With the enormously increased number of subscribers, other and different signaling and switching arrangements had to be thought of. Well do I remember the sheet of paper on which the general manager and superintendent laid out the largest strap switchboard ever dreamed of, and which they thought practical to use. One night they asked me to take the drawing home with me, and figure out the number of calls such a board would be capable of accommodating simultaneously. The subject had been in my mind before, and I frankly told them that "it would be useless to provide such a strap switch; life was too short to do the subject justice; that nothing short of what is now termed a Multiple Switchboard would answer the purpose of a very large office." I urged upon them the advisability of constructing such a board as *I then described,* as soon as possible. They derided my idea, giving as one objection which I now recall, the reason "that there would be too much detail about it, and that all the boards must be arranged so as to be seen by each operator." I refuted this idea, but to no purpose, for in proof of their conviction upon this point they disregarded my suggestion and constructed a switchboard on the strap plan, in the form of a hollow square, operated on the outer face. This was somewhat of an improvement over the old methods, and was all that they had while I remained with the company.

Another incident occurred about this time which proved quite a source of annoyance to those engaged in the work of introducing the "American Speaking Telephone" in Chicago. Mr. H. H. Eldred came to Chicago from St. Louis and opened a telephone central office on La Salle street for the Bell Company. This was in the year 1878. Their first attempt was to get the railroad companies, but I had anticipated this move by making friends with all the railroad people to such a degree that, as records will show, the Bell Telephone people could not get a foothold in Chicago until October. In several instances they succeeded in getting telephones put in, but my relations with the railroad men were so strong that they were soon removed. I believe that, had the management of the company using the American Speaking Telephone Company's apparatus in Chicago fully sustained me in this effort, as they might have done, the subsequent history of the telephone business in Chicago, if not in the United States, would have been very different from what it has been. The trouble was that the fact that I had kept the Bell instrument out of the railroad offices so long had given our company a false sense of their security, and as a consequence they refused to give one or two of the principal railroad companies some concessions which they felt they were entitled to. Mr. Eldred, who was an exceptionally bright man, saw his opportunity and immediately took advantage of it. I became so tired of the situation that I soon resigned, and was offered a position with the opposing (Bell) company by Mr. Fay, who subsequently acquired much prominence in the telephone business. But as the Western Union Co. wanted some one to go into Ohio to establish exchanges in their interest there, I did not accept Mr. Fay's offer. Mr. Sunny, now so conspicuous a figure in the electrical field in Chicago, took the position offered me by Mr. Fay, who was Mr. Eldred's successor. I spent some months in Defiance, Tiffin and other places in Ohio with Mr. Frank G. Beach, also a conspicuous figure in the telephone field. After this I returned to Chicago and was subsequently brought to New York by Gen. Stager and employed here for several years, first exhibiting Edison's "Motograph" or Chalk Telephone at the American Institute, then as manager of the Fourteenth street central office, then of the William street office, then of the Whitehall street office. From there, after the consolidation of the Western Union and Bell interests, I was made superintendent of repairs and attachments for the Metropolitan Telegraph and Telephone Co. I finally resigned that position for the purpose of organizing an electric construction and supply business in New York, under the firm name of F. E. Kinsman & Co. The business of this firm was subsequently transferred to the corporation known as the Electric Construction & Supply Co., now so prominent in the electrical field in connection with the arc lamp on low potential circuits.

It has been a "long circuit" leading up to the present perfected state of the telephone business, but the old timers can never be persuaded of the fact that telephoning from New York to Chicago under present improved conditions, compares as an achievement, with the similar feat in 1883, or with transmission from Defiance, Ohio, via Detroit, Michigan, and Ft. Wayne, Ind., to Chicago in 1879. The circuit then used was the Western Union wire. I am sorry that I cannot recall the names of those who participated in this, then, remarkable and successful effort at "long distance telephoning." Some three or four years after, I had the pleasure of hearing the familiar voices of Mr. Goodrich and Mr. Scribner of the Western Electric Co., over a circuit running from 35 Broadway, New York, to Chicago, and although I had not seen Mr. Scribner or heard his voice for two or three years, I recognized it at once without having been previously told who was at the Chicago end of the line.

The latter day history of the telephone business is too well-known to render desirable any remarks which I might make upon the subject. Others more intimately related to current telephone work, could undoubtedly furnish much interesting and valuable information. I do not wish, however, to close without speaking of some of my associates who were early pioneers in this work.

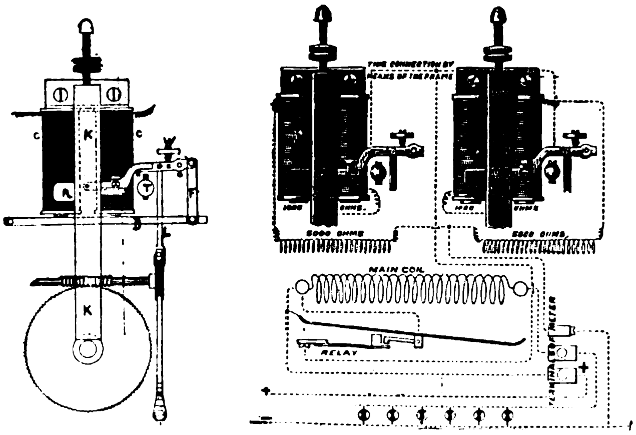
First among those whom I now recall was the late George M. Phelps, respected and honored as the head of the Western Union shops of this city. I made his acquaintance through the courtesy of the late Hon. George Walker. Well do I remember his earnest manner, his vivid prediction of the ultimate future of the telephone business. Also Mr. Summers, electrician of the central division of the Western Union Telegraph Co., Col. Wilson, then superintendent of one of the Western districts of the Western Union Telegraph Co., and Chas. H. Wilson, his son, late general superintendent of the Chicago Telephone Co. The lamented General Anson Stager gave me many words of counsel and good cheer, besides paying the expenses of my application (the first ever filed in the United States Patent Office) for a patent for a multiple switchboard for telephone service—purchased by and now the property of the Western Electric Co.—at a time when no one else was willing to accept it as a future possibility. Those engaged in the latter development of the telephone enterprise well remember the genial Wileys, the Chinnocks, and hosts of others who bore a hand in the early telephone days and who are now, many of them, engaged in other electrical enterprises.

THE PENTZ-RECKENZAUN ELECTRIC METER.

BY

James A. Pentz.
and
Anthony Reckenzaun

About the year 1881, Profs. Ayrton and Perry constructed a meter and published results based upon the difference in magnetization of two clocks, one of which was fitted with a magnet in lieu of the ordinary lead or brass bob weight, the arc of the swing taking place over a solenoid coil, through which circulated the current to be measured. Shortly after this, Dr. Aron brought out the meter which is associated with his name, and is now well known. In this form the registration which represented the measured consumption of electricity was given on a dial, the difference in time between the two clocks being taken mechanically by differential gearing, thus simplifying the use of such a meter, and reducing the necessary calculations which resolved themselves into multiplying the reading by a constant to obtain ampere hours, or units, assuming constant pressure on the supply mains. Recognizing the difficulty of all clock meters, which Profs. Ayrton and Perry discovered, the writers designed instruments with the view of freeing them of all the weaknesses which were inherent in such clock meters. This involved several years experimenting and assiduous attention until the instrument now to be described reached its present commercial efficiency. Some of its main features are, that the meter contains no springs, no loosely hanging pendulums, no clock work arrangements, no escapements, and yet it is a perfect timekeeper owing to the force of gravity being utilized for actuating the oscillating bars. The replacement of escapement spring clocks by electro gravity synchronized pendulums, the double pendulum, metal case and slate base, but most important of all, the exemption of the clocks from driving any gear and reducing them to simple governors—their proper function—will rank as advances.



Figs. 1 and 2.—The Pentz-Reckenzaun Electric Meter.

The necessity in older types of meter for the clocks to supply the power required by the differential gear militated against their recording with the accuracy which, in principle, the system was capable of attaining. The new meter requires no attention in the way of winding, being driven by current taken from the supply. The cost of maintenanec and driving should be small, and as an extremely low current only is used in the driving magnets—somewhere about $\frac{1}{80}$th of an ampere—many of the existing objections raised to the employment of a potential circuit in a meter do not apply to this. The recorded value can be given directly in units, and the adjustments allowed in the design, with this end in view, will be dealt with below. The permanent magnet meter is, of course, restricted in its employment to direct current circuits, but a similar adaptation is in view to render such a meter of use for alternate current work.

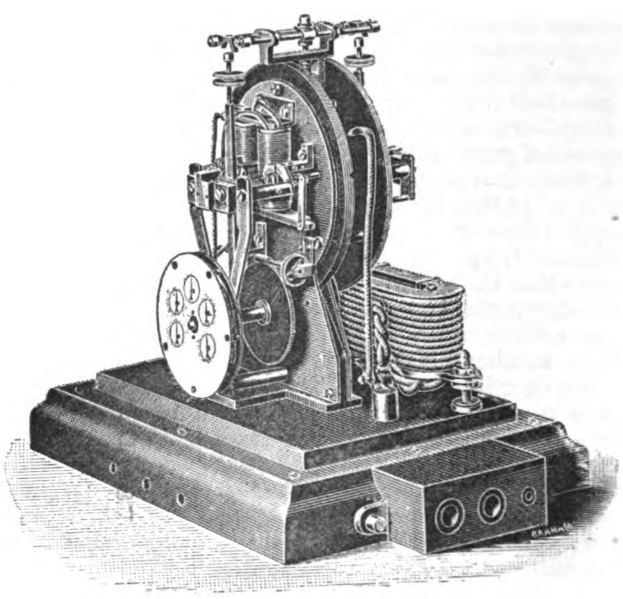


Fig. 3.—The Pentz-Reckenzaun Electric Meter.

The mechanism in the new meter may be considered under three heads; first, the standard metronome; second, the electrically influenced pendulum and its gear; and lastly, the recording and indicating apparatus. The electromagnetic driving apparatus and the pendulum bar of one side of the meter are shown in Fig. 1. Fig. 2 shows the connections of the meter in a circuit, and introduces the relay which closes the driving circuit when the meter is in action. When a current circulates in the main coil owing to a demand on the consumer's premises, the magnetic needle of the relay is deflected, closing the driving circuit and starting the pendulums. As the arrangement of both pendulums is electrically similar, it will only be necessary to trace the course of the current in Fig. 1, which represents half of the mechanism, to understand the action of the meter. The bar, K, is insulated from the frame, and is connected to one end of the electromagnet coil, C. The other end of the coil, C, is taken to the negative side of the lamp circuit, through a resistance of 5,000 ohms, and the potential terminal on the right hand side of the principal terminals, which is connected to the other side of the circuit by a small well-insulated wire. The positive side of the circuit is made through the relay to the frame of the magnets, and thereby the contact screw enables the current to flow to the pendulum bar, thence through the coils and the route described. At the moment the current is turned on, the armature, D, will be attracted, and consequently the pin, H, on the lever, E, will fall, permitting the full weight of the gravity piece, to drop upon the cross piece, R, which is a lateral extension of K, and thus the latter is started into vibration. When the end of the gravity piece strikes the stop, T, the driving circuit is broken by R leaving the screw, S; the armature, D, therefore, immediately falls, and in so doing, resets the pin, H, to its first position, being limited in its upward movement by the stop screw, W. On the pendulum swinging back, the cycle of operations is again repeated, and this continues so long as the relay needle is deflected by current passing through the main coil. The driving power of the metronomic systems is, therefore, obtained by the force of gravity, which acts upon a definite mass free to fall a given distance, and is, therefore, independent of the variation in driving current due to fluctuations in the voltage on the mains. The registration is effected by causing the dependent catch bar, L, to actuate the ratchet wheel shown on Fig 1, so that for every complete swing of the bar, K, a tooth in the wheel is moved forward and the swing registered upon the recording apparatus.

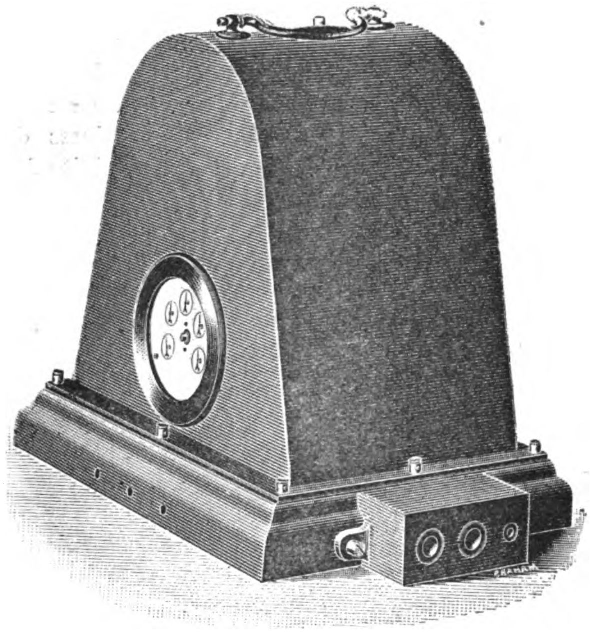


Fig. 4.—Pentz-Reckenzaun Electric Meter.

The arbor of one clock being hollow allows the arbor of the other one to be brought through it. The former carries the dials on a frame, the latter a wheel which gears into one on the frame, so that if the two axles revolve together the relative position of a pointer fixed to the wheel carried by the frame, and a point on the dial itself is unaltered. When, however, one axle is given a higher rate than the other, the difference is indicated by a displacement of the pointer and by suitable counting gear the registration of consumption is effected.

Such sparking as might occur with the small current broken periodically at S, has been practically eliminated by a special compound-winding of the magnet coils. The bar, R, and screw, S, are at different radii from the centre of vibration of K, so that a rubbing contact is ensured in preference to merely the butt contact which might foul slightly after a period of use under practical conditions. The main coil, through which passes the current to be measured, is a solenoid of special shape and very low resistance. It is placed with its centre below the point of suspension of the magnetic pendulum, whose rate of vibration it accelerates positively by virtually increasing the effect of gravity upon the bar. The relay needle underneath the main coil is deflected by less than the current required by one lamp and so starts the clocks, which cease to register when the current is switched off.

The adjustments are three-fold, the first and second being only attempted by the makers, while the third is open to the meter testers of supply companies. For synchronizing the two bars and timing their vibratory beats two nuts are arranged on screwed extensions of the pendulums, while the fine adjustment is given by slight variation in height of contact screw, S. These two means enable meters to be calibrated so as to start registering without difficulty, maintain straight line curves, and read directly in units. If, however, the standards of makers and consumers vary, a final adjustment can be made by raising or lowering the main coil, which is mounted on screwed legs with leveling and back nuts for this purpose. No tampering can occur when the meter has been passed for service, as two covers are used, the first covering up the mechanism and being sealed by the local inspector, while the second contains the three terminals only, access to which would be open to the supply company but sealed by them to prevent unauthorized interference. The engravings Figs. 3 and 4 show the meter with the mechanism exposed and with its case, respectively. The case of the meter is of japanned metal, fitting air-tight to the base. The parts are mounted on a slate base set within a cast-metal frame for strength, while the supporting framework of the parts is utilized as magnetic shields, screening the driving gear of the clocks from one another and from the magnetic pendulum which is given every surrounding possible to ensure accuracy.

TROUVE'S LUMINOUS FOUNTAINS.

The success of the luminous fountains at the Paris Exhibition of 1889 suggested to M. Trouvé the idea of producing the effects on a small scale and cheaply. Several forms of this small fountain are described in the *Bulletin de la Societe d'Encouragement.* Instead of illuminating the water jets by lateral mirrors, M. Trouvé lights up with an incandescent lamp at the focus of a parabolic mirror a sort of inverted glass with apertures for the liquid. M. Trouvé also here describes his method of imitating lightning at one of the Paris theatres. Instead of flashing lycopodium powder behind a broken line cut in the scenery (the old plan), a long bamboo or other flexible rod is used, having a small incandescent lamp of great brilliancy at the end, with a foot commutator, enabling one to make or break the circuit at will. The rod is moved quickly down in a zigzag direction at the proper moment. The sound of the wind in a storm is imitated by means of a double-action pump and two sirens; and that of hail by throwing coarse sand against an osier screen.

REFLECTION OF ELECTRICAL WAVES.

An interesting note by M. Birkeland appears in the *Comptes Rendus* for April 17, on the reflection of electrical waves at the extremity of a linear conductor. By an application of Prof. Poynting's theorem concerning the movement of the energy in an electromagnetic field to the case of a Hertzian oscillator, he has shown how the damping of the oscillations depends on the nature and position of the conductors in the neighborhood. He also accounts for the fact that, when the distance between the first stationary node and the end of a wire is determined by means of a secondary circuit, the value found is smaller than that obtained by a direct measurement of the potential along the wire, by showing that the paths along which the magnetic energy travels are extended beyond the end of the wire, so that the wave has, so to speak, to make a detour round the end of the wire, and is thus retarded.

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THE MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE annual meeting of the American Institute of Electrical Engineers just closed, judged from the standpoint of the number of papers submitted, has naturally been subordinated to the Electrical Congress to be held in Chicago next August. Under the circumstances, it was not to be wondered at that many authors preferred to hold back their contributions until that time, and, quite properly so, when we consider that the Congress will, in many ways, be an adjourned annual meeeting of the Institute.

The experimental lecture of Dr. M. I. Pupin, of Columbia College, cannot fail to have impressed all those who were present with the great importance of the resonance effects in induced circuits which were first recognized and practically applied by Mr. Tesla. Dr. Pupin's remarks also showed that though much has been done within recent years towards increasing our knowledge of the properties of iron, there still remains work to be done. The lecture was admirably delivered and exhibited no small skill and grasp on the part of the author.

The same evening, at Columbia, saw also a splendid lecture delivered by Dr. W. J. Morton on the place of electricity in medicine. The members of the Institute and the New York Electrical Society are to be congratulated upon having such an opportunity afforded them of learning how closely in touch advanced physicians are with the very latest electrical work and thought.

It deserves notice that the new system of voting tried by the Institute came through the ordeal very successfully. A method of voting must be judged broadly by the number of votes it brings out, and as 466 members out of a total of 675 scattered all over the globe sent in ballots, it would seem that the wishes of the body were elicited and expressed in a very satisfactory manner. In some respects the election rules are capable of improvement, but chiefly on the lines of greater simplicity and clearness. The Institute is to be congratulated on the possession of an abundance of good presidential timber, and on securing Prof. Houston as its head for the Columbian year.

THE WESTINGHOUSE REPORT.

THE annual report of the Westinghouse Electric and Manufacturing Company, printed in our issue of May 17, unhappily, like the report of the General Electric Company, and the reports of most other industrial companies, fails to give all the information concerning the business of the company that shareholders and the public would seem entitled to, in view of the fact that its stock is dealt in on the Boston Stock Exchange. The financial and business statement consists of a balance sheet only, and from it alone no satisfactory knowledge can be deduced in respect to the business and gross earnings of the company.

The net earnings are given as :

From business	$1,491,817.13
From other sources	112,766.60
Total	$1,604,583.73

The text of the report states that this is after charging to operating expense, $84,747.31 for alterations and additions to buildings, and $155,484.87 for maintaining machinery and tools, and $58,188.86 for interest and discount. The gross earnings would thus appear to have been $1,903,004.77. A statement of the gross business done and of manufacturing cost would make the exhibit of the company's affairs tolerably complete.

It has doubtless been observed, by those interested in electrical securities, that the Westinghouse company, since its bitter experience of two years ago, has conducted its business on conservative methods and that it has been gaining strength gradually. It has notably come to the front in electric railway work. Its success in this field has been a conspicuous feature of the past year or more of electrical industry. It is well known that when the company was reorganized in 1891 its administrative and general expenses were brought down to the lowest practicable figures consistent with efficiency. Under these circumstances there seems to be no valid reason for doubting the substantial accuracy of the figures given in the report as net earnings: yet since May 1 the common stock of the company has declined on the Boston Exchange from 32 to 28 on May 19, going as low as 24 meantime.

Like the General Electric Company, the Westinghouse Company includes in its statement of assets an enormous sum for intangible property in patents, etc.—nearly one-third of the total assets—(Total assets, $14,450,806.; charters, franchises, patents, etc., $4,378,031.)—a sum undoubtedly greatly in excess of a reasonable liquidation value.

It is gratifying to note President Westinghouse's statement that the company's apparatus "can be sold for cash to responsible parties and that the prevailing belief that long credits must be given, or that stocks and bonds must necessarily be taken in order to secure business, is not correct." It will be noted that while the stocks and bonds held as assets are but $65,000 more than they were a year ago, the item of "advances to leased companies" has been reduced by $1,006,000, and that capital stock liabilities have not been materially increased.

We believe that the Westinghouse and other great electrical companies could do nothing better calculated to increase confidence on the part of investors and the public than by making a full exhibit of their business and sources of profit in their annual reports.

WORLD'S FAIR DEPARTMENT.

BELKNAP MOTORS AT THE FAIR.

THE very first of the exhibitors in the Electrical Building to complete their display were the Belknap Motor Company of Portland, Maine, who show a very interesting collection of motors, fans, generators, etc. The exhibit occupies Space 2, Section E, and looks somewhat lonely among the piles of boxes and half-finished shows on every side. Not only, in fact, was this company the first, but it was absolutely the only one in the building whose exhibit was ready before the official opening on the first of May.

The apparatus shown is nearly all in actual operation and is driven by a 10 h. p. 220 volt "B. C." (Belknap Standard) motor. This operates a 100 light standard dynamo of 110 volts. The current generated by this machine is used to operate the various pieces of mechanism, lamps, etc., comprising the exhibit. Prominent among the machines shown is a combined exhaust fan and motor of one kilowatt capacity running at 670 revolutions. The motor is multipolar and can be run in either direction with equal efficiency. The combined machine has but two self-oiling bearings, one at either end of the shaft. The armature of the motor is built on a cast iron sleeve together with the commutator and enclosing heads, so that it can be readily removed from the shaft by simply slacking a set screw. The armature core is built up of soft iron wire wound between the two end discs, the return wires being run across at 90 degrees to adapt it to the four pole magnet. A series of cross connections in the commutator permit the use of only two carbon brushes, also placed at 90 degrees apart and situated in the most convenient position for adjustment. A long range spring is used for feeding the carbons and the brushes require but very little attention. The field magnet consists of a single casting with a projection at the commutator end for supporting the bearings, and a part of this casting completely encloses the two field coils in such a manner as to protect them from injury. These are wound on metallic spools and are easily put in place or removed at will.

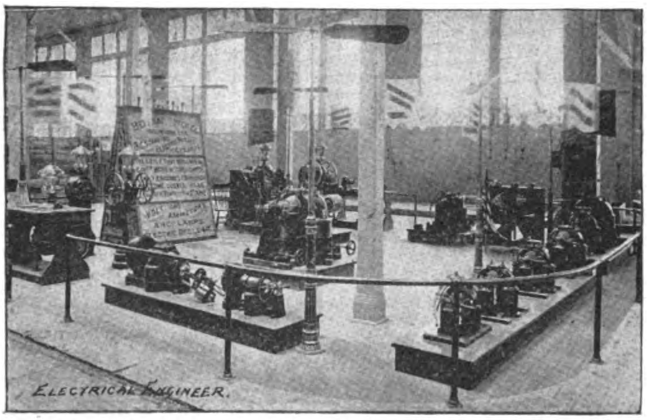


EXHIBIT OF THE BELKNAP MOTOR CO., WORLD'S FAIR.

The generator also runs three motors of 5, 3 and 1 h. p. respectively and also a little ½ h. p. motor which operates a moving sign. This sign is in itself a striking feature of the exhibit. It is 8 feet high and 5½ feet wide and consists of two frames separated at the bottom and resting against one another at the top like an easel, or, to be more exact, like a hen coop. On these frames are stretched the sign proper, having the name of the company in letters cut out of the background and allowing a moving piece of canvas to be seen through them. This is painted in various colors horizontally and diagonally, so that when operated by the motor the letters constantly change color in unexpected ways. The same motor also runs two revolving fans at the top of the sign, each carrying colored incandescent lamps at the ends of the blades. There is also a row of colored lamps above the frame as well as several inside to illuminate the perforated letters.

Other important machines forming part of the exhibit are several "Cyclone" power mills electrically operated and made exclusively by this company. In one form, that of the "No. 1 Cyclone" the motor is placed in the base of the frame with its armature and shaft vertical and is connected with the horizontal shaft through which the grinders in the top of the mill are attached by machine cut gears. The "No. 4 Cyclone" is built on a different principle. The motor is contained in the base as before but the armature shaft is horizontal and is connected with the horizontal grinder shaft by a belt also contained within the case. A clever device for calling attention to this machine is a circular opening covered by plate glass through which are seen two revolving discs moving in opposite directions on the same shaft, the outer one painted black and having curved openings leading from the centre to the outer edge through which is seen the under disc painted black, blue, green, red, yellow and white. When the two are in motion therefore a kaleidoscopic effect is produced which catches the eye irresistibly. The next power mill, the latest invention of the company, is known as the "Cyclone No. 5." This stands upon the counter and has its motor suspended from below and connecting with two separate sets of grinders, for fine and coarse work, either of which may be called into operation by simply turning a switch. The machine is the only one of its kind and, as will be seen, occupies but very little room, and that underneath the counter in the least valuable space. These mills are also made and shown with water motors instead of those operated by electricity.

Perhaps the most interesting device in the exhibit is a portable rotary electric drill with a magnetic attachment which holds it against the work while in operation. This machine is light enough to be easily carried in one hand and is applied at once to any part of the casting to be drilled, the necessary power being taken from the nearest lamp socket. It consists of a small electric motor made entirely of wrought iron, running at high speed and geared with a ratio of 1 to 10 to a spindle that carries the drill chuck, and has a sliding feather which allows it to move back and forth in obedience to a hand-feeding screw at the end. The frame for the support of the motor, spindle and gearing is all of one iron casting. The drill is held against the work by a magnetic "sucker" consisting of a cup-shaped piece of cast iron enclosing a coil of wire taking its current from a shunt from the motor.

The same generator that furnishes current to the motors, etc., also operates both arc and incandescent lamps about the space, while in the centre stands a 250-light incandescent generator showing the company's workmanship in machines of this class. The Belknap Company build dynamos of from 5 to 500 lights and motors from $\frac{1}{8}$ to 50 h. p. Their ammeters and voltmeters are also shown. Besides these there are specimens of combined dynamos and water motors, as well as a 60-light dynamo coupled directly to a high speed engine built by H. R. Stickney of Portland, Me., while a number of revolving fans on ornamental standards about the space will keep things cool enough for comfort during the hot weather.

Mr. G. W. Brown, the president and general manager of the company, is himself in charge of the exhibit.

THE WORLD'S FAIR ELECTRIC FOUNTAINS.

It may be remembered that the *Electrical World*, in a casuistic editorial recently published calling attention to a profusely illustrated description of the Stieringer fountains at the World's Fair, discredited the accuracy of an article on the same subject that appeared in The Electrical Engineer of the preceding week, and also ridiculed the authenticity of the plans and working drawings accompanying it. Upon my attention being called to these statements, I called upon Mr. E. J. Spencer, the official in charge of the exhibits of the General Electric Company and also of the construction of the fountains in question, for permission to confirm the plans shown in the Engineer. Not only was this immediately granted and acted upon, but I have also his assurance that those plans, as printed, are exact copies of those that have been faithfully carried out under contract between the General Electric Company and the World's Fair people. In addition to this he has kindly consented to go over and verify the material at my disposal.

Not being "900 or 1000 miles" from the scene of action, I have visited the Mechanical and Electrical Engineering Department where duplicate plans, forming part of the contract, are on file, and have found after a careful examination that not only do these plans correspond exactly with the originals furnished The Electrical Engineer and photographically reproduced in its pages, but also, upon a re-inspection of the fountains themselves, have confirmed the statement that the work has been carried out absolutely in accordance with these plans with the single exception of a slight modification of the exterior curve of the lip of the basin. A bottle of soda was unfortunately spilled on the blue print in this spot and the line, being obliterated, had to be re-sketched in pencil.

No plans whatever are shown in the *World* article, but all the illustrations are reproduced from sketches, most of which are well executed but are of no value from an engineering standpoint. The *World* stated that the Engineer was incorrect in asserting that the lamps used consumed "from 80 to 90 amperes" and then took the figure 80 alone as being accurate. The lamps, according to those who operate them consume "from 80 to 90 amperes and have run up to 100." The *World* also assured an intelligent public that the standard search light has a c. p. of 250,000 *spherical measurement*! This would not require comment except that the accuracy of the article is editorially vouched for. The switchboard is not of "hard rubber" but of slate, and the signal apparatus is the Knowles Navy signalling code box, especially adapted to this work. An investigation shows, that the engine signals, improvised for temporary use on the opening day alone, and still hanging in the engine and pump room, have been literally copied in the *World* article, and made to serve as the code adopted for the permanent operation of the fountains.

The *World* stated that the Engineer was wrong in regard to the diameter of the water mains, 24 inches. The main is 24 inches in diameter, according to the highest authority on the subject, until it reaches the fountains. The service pipes to the valves are 16 inches in diameter though the contract called for a 24 inch service. Each fountain is served by a bifurcated 16 inch header. The two 16-inch headers have approximately the same capacity as the one 24 inch service. As however, this service was very short and direct, the contractors permitted the Exposition Company to alter their plans to the extent of taking a 16 inch short service from the mains to the fountains. The mains are however as stated by the Engineer, 24 inches in diameter.

The *World* article said "The general plan of these fountains is not new. We believe they were first worked out and patented in England by Sir Francis Bolton. Mr. Dwight Wiman purchased the patents for the United States for his father, Erastus Wiman," etc. Sir Francis Bolton's United States patent, the one that Mr. Wiman bought is No. 312,958, issued February 24, 1885, entitled "Floating Apparatus for Producing Illuminated Fountains," and its only claim is in these words:

> "Floating apparatus for producing illuminated fountains, consisting of a floating vessel, provided with pumps, water mains and jet nozzles and illuminating apparatus sheltered by glass from the water and spray of the jets."

The drawings accompanying the patent show a tub-like vessel provided with the apparatus mentioned in the claim, and nothing else. So far as patents are concerned, however, I noticed all the way from the pumps to the water jets a number of patented devices and apparatus, such as generators, wires, switches, valves, conduits, junction boxes, etc., etc., but saw no reason to detract from the credit due the designer, who has produced an original monument of engineering skill. The fountains are not only full of patents, but also contain many inventions not yet public, but which will form the subject of patent specifications in good time.

The details of many of these electrical features have been, for obvious reasons, denied to us and also to all others, and such details, where published, were surreptitiously secured without the the knowledge of anyone in authority, while the Engineer article was twice submitted for revision, correction and approval before its publication and received authoritative sanction from the officials directly interested and concerned. In fact, I learn that the playful little passage as to the "throbbing" and "thrilling" of the fountains was inserted by special request, the supposition being that most American readers would be able to appreciate its quiet humor. But as the point is not material, I have not endeavored to determine whether four minutes is or is not the exact time necessary for either delightful sensation.—G. B. M.

In addition to the above we would say that we have received a copy of the following letter with a request for its immediate publication.

Chicago, Ill., May 16, 1893.

The Electrical World,
Times Bldg., New York.

Gentlemen:—

In your issue of May 13 you have seen fit to publish an account of the electrical fountains at the World's Fair as constructed and operated by the General Electric Company, from the designs of Mr. Luther Stieringer:

In my capacity of representative of the General Electric Company, in the execution of this work, I wish to say that the article in question may be misleading in so far as you state that the fountains are not constructed in accordance with the plans published in The Electrical Engineer of May 3. These plans are photographic reproductions of the original tracings, blueprints of which formed part of the contract executed between the General Electric Company and the World's Columbian Exposition. As a strict conformity with these plans is called for by the contract it may be inferred from your statement that our contract obligations have not been fulfilled. This inference would be unjust, inasmuch as there has been no deviation whatsoever from these plans. I trust that this statement will be published.

I wish also to call your attention to certain detailed electrical and other data in the same article. However correct or incorrect, it has been secured from improper, irresponsible persons, without the approval or sanction of anyone in authority. This is a matter of far more gravity than the mistaken statement just referred to.

Information asked from me has always been cheerfully furnished except where business interests prevented. In one recent instance upon your request for certain diagrams, rather than deny you the same upon my own responsibility I telegraphed East for advice. I then informed you that it was considered inadvisable to publish same at that time. Much to my surprise such information as your representative could get, whether by permission of irresponsible parties or not it matters not, was published the following week.

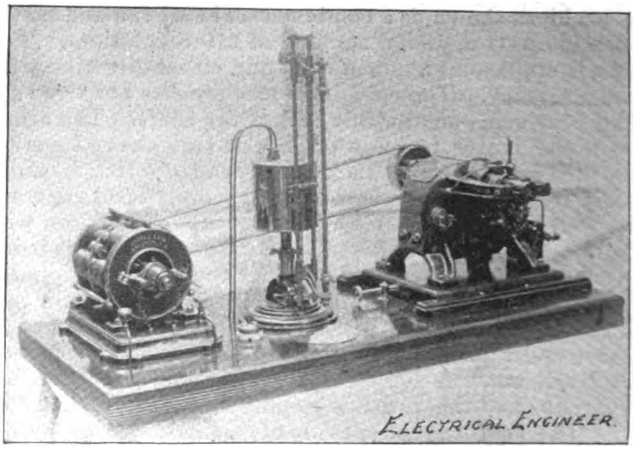
Data for this fountain article has been obtained by methods of stealth and misrepresentation which I feel sure your able and influential journal cannot approve.

Always at your service, I have the honor to be,
Yours very truly,
(Signed) E. J. Spencer.

AN HISTORICAL DYNAMO.

BY E. A. BARNES.

While the electrical journals are calling the attention of the public to the original direct-connected Edison dynamo, I feel that it is due to Mr. James J. Wood, the general superintendent and electrician of the Ft. Wayne Electric Co., that he should get credit for having designed a dynamo over thirteen years ago which embodies all the ideas found in the very latest type of dynamo machine.



The Wood Historical Dynamo at the World's Fair.

The following features are found in this machine which may surprise a great many of your readers. The armature is iron-clad; the fields are multipolar, and cast in one piece; the speed is exceedingly slow for such a small machine (1,700 revolutions per minute). The efficiency is very high; the internal resistance from binding post to binding post being but 1 ohm. It is also fitted with an interlocking commutator, which is found on the most recent pattern of dynamos, and which enables it to be cross-connected, making surprising combinations. It can be made into a self-exciting alternator, a tri-phase alternator, and a direct current machine. Three independent circuits, either alternating or direct, can be derived from this machine without stopping it or making any extensive changes.

This is the identical dynamo for which the Fuller Electric Co. of New York City, for whom Mr. Wood was electrical and mechanical engineer, received a medal for superiority at the American Institute Exhibition in the fall of 1880. The design of the machine from a mechanical standpoint compares wonderfully with the very latest dynamo construction; while from an artistic point of view it is second to none.

This machine is very dissimilar to any of the experimental dynamos made by the designers of thirteen years ago. The machine weighs but 86 pounds as it stands; it will deliver for any length of time 10 amperes and 50 volts at the above speed, enabling a full 2,000 c. p. arc light to be maintained during this period.

The accompanying illustration gives an idea of the machine as it can be seen in the space occupied by the Ft. Wayne Electric Co. in the Electricity Building at the World's Fair. It has been placed there by me as a historical exhibit, which should compare favorably with anything found in the building. This machine is seen in actual operation, running an old style Fuller-Wood arc lamp, and driven by Mr. Wood's first iron-clad motor, which is in itself quite an advance in dynamo designing.

THE DISPLAY OF QUEEN & CO., INCORPORATED.

Queen & Co., Incorporated, have a very complete exhibit of apparatus at the World's Fair, subdivided into six separate displays, one in the Electrical Building and five in the Liberal Arts. These include chemical, microscopical, engineering and meteorological instruments, a complete physical exhibit, containing many interesting pieces of apparatus which lack of space alone prevents us from describing in full.

The World's Fair Electrical Display of Queen & Co., Incorporated.

In the projection department are shown all types of lanterns, as well as a new projection arc lamp for use with either direct or alternating currents, of which further mention will be made later on. The chemical apparatus is very complete and many of the instruments shown are entirely novel in design. The ophthalmological exhibit includes oculists' trial cases, ophthalmoscopes, glasses, lenses, etc., in great variety. The exhibit of the Société Génèvoise includes a splendid collection of dividing engines, standards of lengths, spherometers, comparators, spectrometers, heliostats, phonographs, etc., while those of Carl Reichert and E. Français include instruments for microscopical work and a large variety of cameras, lenses, and other photographic instruments.

The display in the Electricity Building occupies a prominent position immediately at the left of the northern entrance and consists of a Grecian pavilion designed for the company by Prof. W. P. Laird, professor of architecture at the University of Pennsylvania. This is surrounded by show cases containing the apparatus, while around the entire space runs a graceful Venetian railing also designed by Prof. Laird. The exhibit of electrical apparatus is so comprehensive and complete that a description of it here must necessarily be somewhat cursory, and fuller descriptions of the most important devices will be given from time to time hereafter.

In two of the large showcases in front of the pavilion are shown high grade standard resistance sets. In these, platinoid wire is employed, and the temperature co-efficient of each spool is previously determined, only those spools whose co-efficients are identical, being placed in the same box. Among these is an Anthony Wheatstone bridge correct to one one-hundredth per cent., and in which the bridge arms may be rapidly interchanged by a commutator, to correct any possible inequality. The coils are arranged in rows and only one plug is required in each row. An advantage gained by this arrangement is the possibility of placing any or all coils of each denomination in multiple arc as well as in series, which, as will readily be seen, makes possible a much more complete intercomparison of the coils. The bridge arms have a ratio of one to ten thousand and a total range of measurement from one-millionth of an ohm to 111 megohms. These arms may be quickly interchanged by the simple changing of two plugs, an operation only possible in other forms by the change of wires from one set of binding posts to another.

Instead of a thermometer a copper temperature coil is employed, by means of which work of greater accuracy can be done and the average temperature of the coils more readily determined than by the use of the thermometer.

There are also shown several 100,000-ohm boxes. The finest specimen of these is of the multiple pattern and contains ten 10,000-ohm coils. By a manipulation of the plugs it is possible to get resistances of from 1,000 to 25,000 ohms in steps of 1,000. One side of the box has a break by opening which one half may be used as one arm of the bridge and the other half as the other arm, thus getting an exceedingly wide range of bridge arm ratio. Another interesting instrument is a portable testing set 8 inches long by 6 inches wide and deep, containing a Wheatstone bridge, resistances to 5,000 ohms, a commutator for changing the bridge arms, a D'Arsonval galvanometer and 12 cells of dry battery giving 1$\frac{6}{10}$ volts each. These cells are of a new pattern containing no chloride of silver and may be connected up either 3, 6, 9 or 12 in series. These coils are correct to one-fifth per cent.

A standard ohm with a copper temperature coil instead of a thermometer is also one of the notable instruments in this collection. Instead of using a water bath and keeping the temperature constant by means of a flame, an extra casing surrounds the coil and about this is wound a wire through which a heating current is passed. Here is also a "No. 2" resistance set of the Post Office pattern containing an ordinary bridge and rheostat with a thermometer and commutator and giving correct readings to one-twentieth per cent.

In another case is shown a Carey-Foster commutator to be used with a slide wire bridge for the comparison of resistance coils to

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1. See The Electrical Engineer, Dec. 2, 1892, and Jan. 4 and 11, 1893.

enable one to reverse the battery alone, and thus eliminate all errors due to thermo-electric effects. The importance of this will become evident when it is stated that this instrument is used for comparisons ordinarily to an accuracy of one-two-hundreth per cent. and can exceed this if necessary. This instrument also has an arrangement for putting the standard coil in multiple with another coil of known resistance, and thus determining the resistance of the bridge wire. In a modification of this device, the bridge wire is placed on the same base and both commutations may be performed by a single motion, or the battery may be reversed separately if desired. This was fully described by Mr. Elmer G. Willyoung in a series of artices published in THE ELECTRICAL ENGINEER on the exact adjustment of resistances. It is the only instrument in which the commutation can be effected in this way. Besides the comparison of resistances, it may be used for the determination of specific resistance in conjunction with a modification of the standard ohm for determining the temperature co-efficient, by simply shunting the bridge wire with the wire to be measured and then proceeding by the ordinary Carey-Foster method.

Galvanometers of new design and of all sorts, sizes and descriptions form an important part of this display. One of these is a modification of the Thomson square pattern galvanometer in which the terminals of each coil are brought to binding posts on the base. An important feature of this instrument is the rapid interchangeability of the coils. The parts are exceedingly easy of access, and there are no connected wires to be unscrewed. In another new form of Thomson galvanometer, arranged for very high insulation, the terminals are brought to a switchboard and may be connected up in any desired way with the utmost ease. The coils are wound according to the theoretical determinations of Maxwell and Thomson, and five different sizes of wire are used, while the same feature of rapid interchangeability of coils is observed as that just described, and the instrument is provided with an exceedingly long suspension tube for delicate work as well as others of shorter length. An important feature in its design is that the ordinary glass case is omitted, and instead, the cases for the coils are made dust-proof.

A dead-beat reflecting galvanometer of great sensitiveness, containing two coils whose terminals are brought to platinized contacts insulated from the coil frames, will also excite interest. These coils can be interchanged readily and the sensitiveness of the instrument is varied by a screw, making the differential action of the controlling magnet more complete and delicate. There is also a Moler swinging arm tangent galvanometer having a bell magnet carrying a mirror, and also a pointer playing over a scale for coarser measurements. The swinging arm varies the intensity of the effect of the current to be measured and gives the instrument an enormous range.

Perhaps the finest instrument in this branch of the collection is the ballistic galvanometer. In this the coils are connected either in series or multiple as desired, by plugs and flexible cords. The whole system is exceedingly easy of access, and the coils may be interchanged with great rapidity. At the bottom of the case is situated the magnetic controller moved by a screw and revolvable about its vertical axis.

Another interesting and comparatively novel instrument on exhibition is the carbon rheostat. This consists of a case containing a number of carbon pencils whose resistance is varied by pressure exerted upon them by means of a screw bearing upon a plate at the top. There are six of these screws in the case, each of which will vary the current from zero to 25 amperes, and the system can be arranged either in series or in multiple so that currents as high as 150 amperes can be obtained. For the calibration of ammeters, storage cells sufficient for the necessary current are placed in parallel; the ammeters, including the standard, are put in series with the battery and the rheostat, which latter is then varied to give any desired current. This instrument has entirely superseded the use of German silver resistance in all of Queen & Co.'s laboratory work.

In another case by themselves are shown various designs of reading telescopes and scales, lamp stands and scales and also a large number of different patterns of keys. Next to this is a case of induction coils of all sizes and patterns, while close by are samples of standard condensers of unique pattern and of the very highest grade, as well as others suited for purposes requiring less accuracy. The alternating current instruments occupy a case by themselves and include Siemens dynamometers measuring from two-tenths to two-one-hundredths ampere, Cardew voltmeters, a new modification of Mascart and Ryan electrometers and a contact maker to be used in connection with the electrometer for obtaining the potential curves of alternate current machines. Some of these instruments are exceedingly interesting and will be more fully described and illustrated later.

Two of the cases contain respectively, Wimshurst and Holtz machines and photometric apparatus, while in two others may be seen a complete list of Queen & Co.'s electric measuring instruments for students' use, the most striking of which are the earth inductor, spiral coil voltameter, D'Arsonval galvanometer, universal tangent galvanometer and a variety of condensers. The second pair of Hertz mirrors in this country also form part of this exhibit.

Lord Kelvin's instruments occupy two more cases and include several balances, electrolytic apparatus, portable multicellular electrometers, rheostats for both small and large currents, vertical pattern electrometers and also a piece of apparatus never before seen in this country, namely, an electrostatic balance for measuring up to 50,000 volts. Crookes, Geissler and spectrum tubes occupy a case in a prominent position against the outer wall of the pavilion and make an exceedingly striking and brilliant display against their background of black velvet.

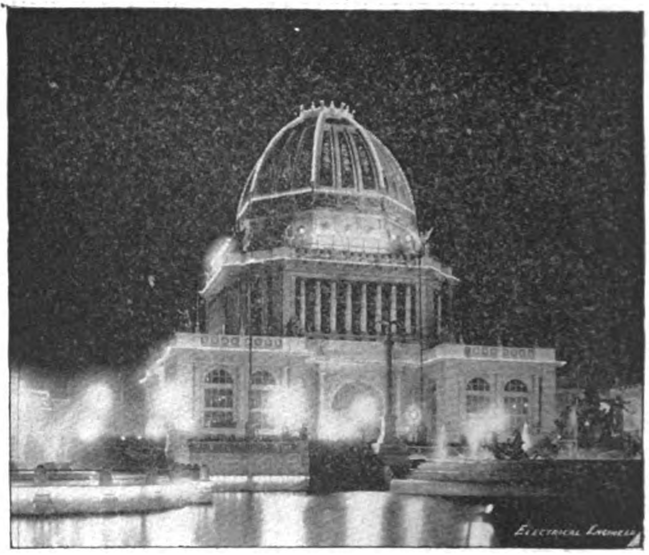
The pavilion itself contains two rooms, the larger of which is fitted up as a cozy office or reception-room and contains an excellent electrical library, including all of the current technical journals on file. The walls are embellished by two switchboards, the smaller of which has fastened upon it a fine collection of Thomson ampere gauges, the largest reading to 6,000 amperes, and multicellular voltmeters for central station work. The larger contains commercial measuring instruments including Cardew voltmeters of various patterns and ranges, and magnetic vane ammeters and voltmeters.

Opening off the reception-room is a completely equipped darkroom in which is an electric light photometer and also a very fine projection lattern and a number of Geissler tubes, etc., all connected up and ready for use.

All the exhibits of Queen & Co., Incor., are in charge of Mr. Clayton W. Pike, B. S., assisted by Mr. Edwin R. Keller, M. E., and Mr. Edwin F. Northrup, B. S., who are fortunate in having one of the most complete and satisfactory exhibits at the Fair to show to visitors.

ILLUMINATING THE ADMINISTRATION BUILDING.

THE cut herewith, made direct from photograph, gives a good idea of the beautiful effect obtained in illuminating the grounds and buildings by electricity, at the World's Fair, after dark. The edifice shown is the beautiful Administration Building, which stands immediately behind the MacMonnies and Stieringer fountains and looks out towards the Lake, over them. As will be observed, the outline of the building is strongly marked with incandescent lamps, while the arc lights on the Plaza are also in operation; and the fountains are playing.



THE ADMINISTRATION BUILDING BY NIGHT.

THE BELL TELEPHONE PRESS OPENING.

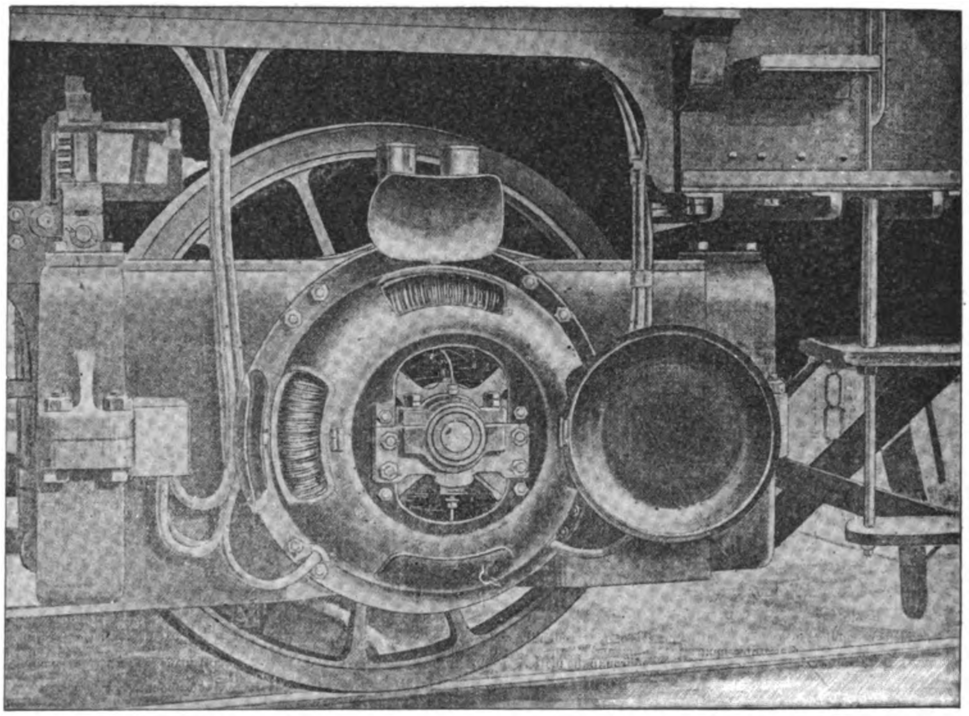
A VERY informal opening of the Bell Telephone temple in the Electricity Building, for representatives of the daily press and such of the public as desired, took place on Thursday afternoon from 3 to 5 o'clock. During the first hour, all were given an opportunity of talking over the Long Distance line to New York, after which one hour was devoted to an exhibition of the loud speaking transmitter in the rotunda, or inner court of the temple. Mr. Hovey delivered a number of little explanatory lectures, each lasting five minutes, the guests entering by one door and passing out by another so that all might hear and the room be kept no more than comfortably filled. The exchange and the museum of telephonic curiosities were also shown and explained. A picture of the building was given in the last issue of THE ELECTRICAL ENGINEER.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC LOCOMOTIVE FOR SUBURBAN TRAFFIC.

In our last issue we described the attempt now being made by Mr. Heilmann to solve the problem of high speed electric locomotion on railways, involving the generation of the current on the locomotive by an engine and dynamo. The Northern Railroad of France some time ago also decided to make experiments with an electric locomotive but adapted especially to the working of its local and suburban trains.

The locomotive consists of a carriage mounted on six wheels of equal size. Two of the axles carry motors, the third being only a bearing axle. The car serves as a platform to carry storage batteries which supply the power, leaving room for the engine driver, the reversing levers and the other machinery. These storage batteries are of the type made by the Société du Travail Electrique des Métaux, and are made up of elements consisting of 11 plates 800x400 mm. in size and 6 mm. thick. There are 80 of these elements on the locomotive, and as each weighs 143 kg., the total is 11,440 kgs. The weight, including all the boxes and connections is 19 metric tons. The arrangement of these storage batteries, the suspension of the plates, their composition and other points, have been carefully studied out. It is calculated that without renewal they will supply power to the locomotive for 6½ hours of constant running at a speed of 46 km. an hour or for a run of 300 km. or about 184 miles. The connections are so arranged that at the option of the engineer combinations giving 40, 80 or 160 volts may be made, to increase the speed, to give the additional power needed on grades, or to start the engine.



Electric Locomotive for Suburban Traffic.

The arrangement of the motors is somewhat peculiar. The journal bearings on the axles are inside the wheels, and the motors are placed outside the wheels on the ends of the axles, which are made long enough for this purpose. The arrangement is shown in the accompanying engraving, which is reproduced from *Le Genie Civil.*

The motors which are built by the Breguet works are of the four-pole type, four in member, two on each driving axle, mounted on springs.

So far this locomotive has worked with satisfaction to its designers; the tests, however, have hardly begun, and no report will be made until they have been continued long enough to satisfy the company as to the work for which this motor is adapted and the place which it can properly and economically fill in the service of the road.

ELECTRIC RAILWAY BAGGAGE CARS.

The Lynn & Boston Street Railway Company is arranging cars with baggage compartments for the convenience of long trip patrons, and is also intending to put on a line of freight cars between Boston, Chelsea, Lynn and Salem, to meet the wants of patrons along the line who are not fully served by the steam roads. These innovations are but the beginning of a new development of "railways," through which, ere long, there will be full fledged "railroads" in the public streets.

LEGISLATION IN CONNECTICUT.

A special dispatch from New Haven, Conn., of May 15 to the *Evening Post*, says: The "General Electric Bill" so-called, probably the most important measure of the session, is now in a curious position in the Legislature at Hartford. It was first passed by the Senate with a few amendments. Then it went to the House, where many minor amendments were added, the proviso in the Consolidated Railroad interest giving the Railroad Commissioners power in ordering roads parallel to steam roads struck out, as was also the prohibition on carrying merchandise. There was added, also, in a rash moment, an amendment practically giving any stock corporation power to build an electric road. In this shape the bill is now in Conference Committee, between the two Houses, with the Consolidated Company, which is generally assumed to control the Senate, pitted against the electrical companies, both present and about to be incorporated.

If the general bill perishes between the two houses, as is possible, a strange state of affairs is likely to ensue; in that case the promoters of the hundred or more electrical road schemes in the State will each seek to have put in their charters privileges which, had it passed, would have been given by the general law. Some will want the "parallel" and "merchandise" rights, others will not, the case varying according to the location and plans of each company. Thus the fight, now concentrated on a single bill, will be distributed among many, and a medley of contests follow of the most complex character; one result of which will be, doubtless, to add greatly to the amount of work before the present Legislature.

The fate of a large number of electric road schemes, particularly of those paralleling the consolidated lines or looking to ultimate business in merchandise, depends largely upon the fate of the General Electric law.

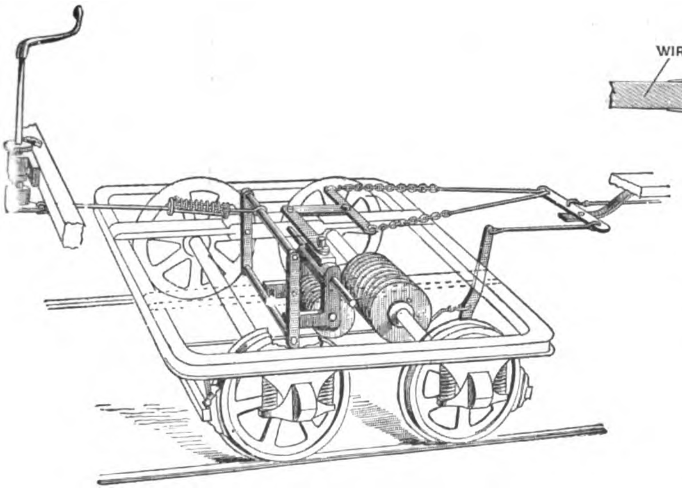
THE ELLIOTT CAR BRAKE.

In the accompanying engraving we present to our readers a diagram of an exceedingly ingenious car brake invented by Mr. G. R. Elliott, of Boston, Mass., which is the result of a protracted study of the conditions to be fulfilled in street railway work.

The mechanism which is of a very simple character consists of a chilled iron cylinder having a screw thread cut upon its surface and firmly fixed upon the axle of one pair of wheels of the truck of the car; a like cylinder of smaller dimensions is hung in bearings at the lower end of a lever frame in such a manner as to bring it parallel to that upon the axle. The fulcrum of this lever frame is an iron rod having loose bearings in the woodwork of the truck frame, and with this rod the lever frame carrying the smaller screw cylinder reciprocates.

To the upper end of the lever frame is attached the rod leading to the brake handle, which rod is divided and has a spiral spring interposed at the junction in such a manner as to make the pull of the brake handle elastic so that a half turn of the brake handle draws this rod forward, causing the lower part of the lever frame which bears the small screw cylinder to move toward the larger screw cylinder fixed upon the axle of the wheels, with which it engages, and by which it and the lever frame carrying it are moved toward one side, or the other, of the car, according to the direction in which the latter is moving.

A link, one end of which is attached to the lever frame, and which moves with it, is connected by its other end to the end of one arm of a three-armed rocking lever, fulcrumed at the junction of its three arms, and operates in such a manner that whichever direction the lever frame takes by reason of its small screw cylinder engaging with the screw cylinder on the axle, the three-armed rocking lever will be moved so as to cause one of two links connecting two of its arms to an ordinary straight lever at one end of the truck frame to draw inward, thus causing the other end of the last-mentioned lever to move outward carrying with it the rod connecting it with the beams of the brake shoes and thus bringing the brake shoes against the tread of the wheels against the stress of springs which withdraw the shoes the instant the brake handle is released.



The Elliott Car Brake.

A very slight turn of the brake handle will bring the screw cylinders into engagement and the smaller cylinder will immedietely begin to move in a direction at right angles to the length of the car and parallel to the axis of the axle upon which the fixed screw cylinder is located; and it will continue to move in this direction until the strain upon the brakes exceeds the pressure exerted upon the brake handle, when it will disengage and fly back toward its former position, engaging again instantly the excessive pressure ceases, and repeating this action until the car stops. This is accomplished so rapidly that the effect upon the car is the same as would result from a continuous pressure of the brake shoes against the wheels, yet the several pressures have the effect of destroying the sudden jerk resulting from the locking of the wheels, and while avoiding the friction and consequent flattening of the peripheries of the latter, is none the less effectual in bringing the car to a stop.

In one end of the rod forming the fulcrum of the lever frame carrying the small screw cylinder is fixed a pin which reciprocates with the rod and causes an angular three-armed rocking lever, in the crotch of which it plays, to throw to one side or the other according to the direction of its movement, and that of the rod from which it projects. This angular rocking lever is attached by one of its arms and a link to a similar lever of a "T" shape; the latter in turn operating an arm engaged above a rheostat. The rheostat also has an arm against one side of which the last-mentioned arm is pressed when going in the direction to cut off the current, when the brakes are put on; but when the brakes are released the rheostat arm is left turned so that the motor man must by the ordinary means within his control turn on the current to start.

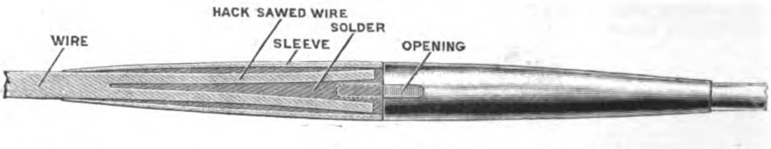
It will thus be seen that while putting on the brakes turns off the current, throwing off the brakes does not turn on the current; but leaves the car at a standstill until the motorman chooses to start it, when the brakes are in a position not to retard its progress.

It is obvious that with the parts for governing the electric current left off, this brake is as well adapted for horse cars as for those operated by electricity.

Considering the fact that the greatest power necessary under any circumstances only requires that the brake handle be turned one half of a revolution, it is clear that the action of the brake is almost if not quite instantaneous; and that its lack of the rigid characteristics of the ordinary brakes makes the wear upon the wheels uniform, thus prolonging their life and usefulness.

THE "TECH" SPLICE.

This is the name given to a new splice designed especially for use in joining trolley and feeder wires, and heavy cables and conductors generally. The accompanying diagram shows clearly the method of its construction and application. To make a "Tech" splice, the wires of a cable are separated—or if a solid wire, the latter is hack-sawed laterally—and the ends spread inside the sleeve of the splice, the interstices are then filled up with solder.



The "Tech" Splice.

The joint can be quickly and cheaply made, and its tensile strength is fully equal to that of the conductor itself. It will also be observed that there is no waste wire at the joint, as the wires are not twisted; in heavy cables the cost of the splice is more than paid for by the saving in this item alone.

The "Tech" joint is made by the Technic Electrical Works, whose offices are at No. 604 Provident Building, Philadelphia, Pa.

RAILWAY DEVELOPMENTS AT TROY, N. Y.

The Troy City Railway has made considerable progress upon its Hoosick and Fifteenth Street extension to connect with the Albia Line, at the junction of Fifteenth street with Congress near the Stone Bridge. Judging from the indications furnished by an inspection of the route, it would seem as if the company were anxious to forestall the legal opening of Fifteenth street, and to have rails laid to that point in readiness to break ground as soon as the city secures the right of way. It will thereby be in advance of any objections to circuit or trolley wire supports from future lot owners. As an offset, it may be stated as a fact, that the experience of the Albia branch would conclusively show that a line even of the antiquated horse cars running through an unsettled district, at a positive loss to stockholders for years, in the end paid those who held on to their stock to an extent not dreamed of in the beginning.

There is now before the directors of the company, a petition containing a long list of signatures of influential residents upon the line contemplated in the petition, who greatly favor it. The plan proposed is to branch off from the depot loop at Union street and build to Grand, thence easterly up the hill to Eighth, and northerly along the line of Eighth to a junction with the new Hoosick and Fifteenth street extension.

Carriage fares to points on Eighth st. are now 50 cents to $1.00; so that it would be no great wonder if residents did favor the new scheme.

The declaration of one and one-quarter per cent. dividend by the Troy City Railway, payable May 1, has raised the stock to 94 to 95.

There are no transactions reported, as holders consider they have a very good thing in hand, and are holding it at par.

CANTON, O.

The Canton Street Railway Company are speaking of building a line to Louisville, Ohio, in the near future. The distance is about nine miles.

The new "Hannah" Block on West Tuscarawas street is being wired for electric lights.

MISCELLANEOUS.

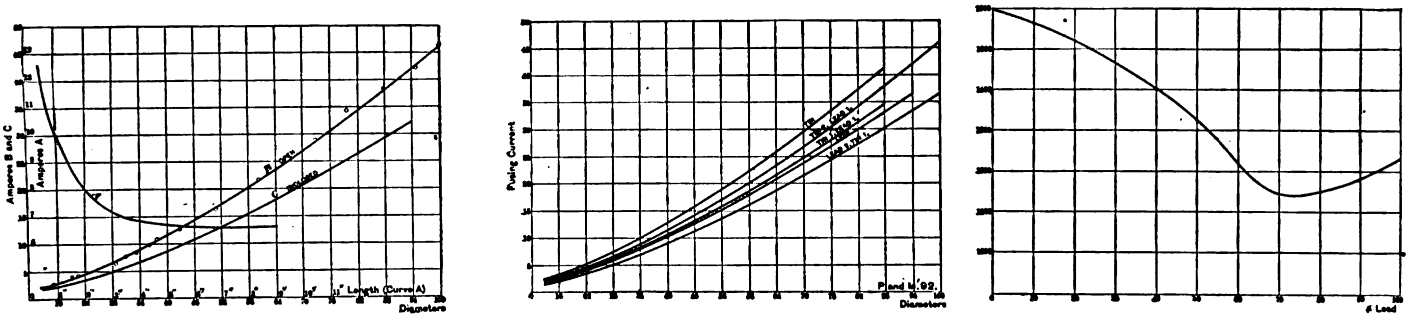
THE ACTION OF CONTINUOUS AND ALTERNATING CURRENTS ON FUSE METALS.[1]

BY C. P. MATTHEWS.

The data here recorded are some of the results of experiments made in the Physical Laboratories at Cornell University. The work may be divided into two parts, viz.: 1. On the behavior of various alloys under the action of direct currents, with special reference to their use in thermal cut-outs. 2. On the *disintegrating* effect of the alternate current on fuse metals.

Preece had shown, in 1884, the relation between diameter and fusing current to be $C = a\,d^{\frac{3}{2}}$, where a is a constant for any given metal or alloy. This result shows the fusing current to be independent of the length of conductor. But the experiments of Kennelly, Ayrton and Kilgour indicate that such is not strictly the case. In 1887, Preece published a second series of tests giving final and corrected values of a as follows:—Copper, 10,244; aluminum, 7,585; platinum, 5.172; german silver, 5,230; platinoid, 4,750; iron, 3,148; tin, 1,642; alloy (tin 1, lead 2), 1318; lead, 1,379. In determining these constants, Preece used six-inch lengths of wire, while to ascertain the value of the same metals as cut-outs 1¼ inch lengths were used. It will be noticed that a value of a is given for only one alloy of lead and tin.

To determine to what extent the fusing current is influenced by the cooling effect of the terminals, pieces of wire of given diameter and composition, but of varying lengths were successively tested. The marked variation in current is shown graphically in Fig. 1, Curve A. It will be noted that while an 8 inch piece fused at 6.6 amperes, a ½ inch piece of the same wire carried 12.5 amperes, or an excess of nearly 100 per cent. before yielding. For lengths of this wire greater than 6 inches the conduction losses are practically nil in their influence on the value of the fusing current.



FIGS. 1, 2 AND 3.—CURVES ILLUSTRATING THE ACTION OF CURRENT ON FUSE WIRES.

Tests were also made on the time interval required for the fuse to blow after current is applied, the results of which are embodied in a number of curves.

The curves B and C, Fig. 1, indicate that the "three halves power law" was quite accurately followed. From each observation of current and diameter a value of the quantity a was computed; the mean of these values was taken, and a curve of calculated fusing currents drawn for each alloy. These curves are given in Fig. 2. It is noteworthy that while the temperature of fusion of tin is considerably lower than that of lead, its *fusing current* is about 24 per cent. higher, due undoubtedly to the difference in the resistance of the two metals. Curve C, Fig. 1, illustrates the effect of enclosing the fusible wire in glass tubes, which check convection and show the influence of the confined fuse block. The constants obtained were as follows:

Alloys.	Per Cent. Lead.	a	Preece's Constant.
Tin	0	1592	1642
Tin 2, Lead 1	33.3	1441	
Tin 1, Lead 1	50	1328	
Tin 1, Lead 2	66.6	1156	1318
Tin 1, Lead 4	80	1131	
Lead	100	1283	1379

Platting these constants as ordinates, with per cent. of lead as abscissæ the curve shown in Fig. 3 was obtained. From this curve the constant for any alloy of lead and tin whatsoever may be taken, and the current necessary to fuse a wire of any diameter readily calculated. These values of a are all lower than those of Preece's announced in 1888.

A number of fuse wires obtained from various manufacturers, were then tested, the results of which are given in the following table. The 2 inch specimen follows very closely the "$\frac{3}{2}$ power law;" the ½ inch piece does not, however.

Rating.	Diameter.	2 in. piece Current.	½ in. piece Current.	¼ in. piece in Fuse Block.
1	.0149	4	5.37	12.08
3	.020	5.72	9.9	17.68
5	.0305	9.65	23.4	32.16
7	.0351	12.76	27.5	35.37
10	.0395	15.78		

One-half inch lengths of the same sizes of wire were successively fused in a porcelain ceiling cut-out block. This block was so constructed that the wire came in contact throughout its length with the cooling surface of the porcelain. The heat was conducted away so rapidly that the current reached the abnormal values shown, before rupture occurred. For example, a 7-ampere fuse did not "blow" until more than 35 amperes were flowing in the circuit. Curves accompanying the paper represent the behavior of the best sample of wire tested. This wire was quite uniform in diameter, and gave evidence of careful rating.

The requirements for an efficient safety fuse may be summed up as follows: 1. Promptness of action. 2. Low fusing point. 3. Permanency under normal conditions. 4. Moderately low resistance. 5. Firm and lasting contact.

Promptness of action requires that the temperature of fusion should not be too far removed from that attained when the wire is being worked at its rated capacity. Moreover, it is important that the metal should not undergo chemical changes produced by the action of the heat which may appreciably alter its melting point. The formation of oxides may or may not promote prompt fusion. In the case of pure tin and some of its alloys, a coating of oxide is often formed which retains the molten metal some time after the temperature of fusion has been passed, ultimate rupture usually occurring with considerable violence. On the contrary, the rapid oxidation of iron and copper wires seems to favor prompt fusion.

In Part 2, the author gives the results of tests intended to show the disintegrating effect of the alternating current on fuse wires. Reference is made to a discussion on this subject before the Providence meeting (Sept. 4, 1891) of the National Electric Light Association, and the editorial comment thereon in THE ELECTRICAL ENGINEER of Sept. 16, 1891.

The author cites the following case illustrating the effect in question: In the lighting system of the Cornell University Library eight 50-volt circuits were supplied with fresh fuses and a record kept of their behavior for a period of three months. During this time it was found necessary to furnish six of the circuits with new fuses, one circuit requiring three such renewals. In this last case the fuse was badly corroded, owing to water dripping from the floor above. The others were in dry and airy places, the contact being bright and firm. One of the fuses had the appearance of being simply cut, the opening being so narrow as to require close examination to detect it.

The fuses experimented on were subjected to the action of the alternating current from 83 to 487 hours, at frequencies of 132 and 250 periods per second and also with continuous current, and the change in resistance noted. The results showed a distinct rise in resistance in all fuses on alternating currents, except in the case of one, the behavior of which was anomalous. The maximum rise was 29.6 per cent in 105 hours. Of the fuses on the continuous current, all but one showed a slight decrease in resistance, the maximum change being only 3.5 per cent. The wires were also tested for molecular change, such as brittleness, by subjecting them to torsion. The change in brittleness in the case of the fuses which had been on alternating circuits was quite marked, being in no case less than 7 per cent.; while the change in those which had been on direct circuits was, with one exception, negligible. These results, together with some data on the fusing points before and after the passage of the currents, are given in a table.

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[1] An abstract of two theses, viz.: "Safety Fuses for Electric Circuits," by J. S. Peck and C. P. Matthews; and "The Action of Alternating Currents on Fuses," by W. S. Rugg and C. R. Sturdevant. Read before the American Institute Electrical Engineers at its annual meeting.

While these results may be considered as only a beginning along a line of work which is of both theoretical interest and practical value, yet they would seem to warrant the following conclusions:

(1). There is a distinct although irregular rise in the resistance of a fuse on an alternating circuit. (2). This is perhaps to be accounted for by a change in the molecular structure of the metal. (3). This results in a decided lowering of the fusing current, in some cases at least, easily sufficient to affect the reliability of the fuse.

LITERATURE.

Telephone Lines and their Properties. By William J. Hopkins, Professor of Physics in the Drexel Institute, Philadelphia. *New York*, Longmans, Green & Co. With numerous illustrations. 274 pages. $1.50.

This compact and handy book is one of the best practical manuals to be found in the field of the electric arts. While it has not been written by an electrical engineer actively engaged in telephonic work, it embodies all that telephonic experts and practitioners have discovered during the last 10 years. It covers all the departments of the service, and while in no sense dealing with the business management of telephone exchanges, touches many points of operation that affect vitally the income and welfare of telephone companies as commercial enterprises. It discusses city lines, whether overhead or underground, long-distance lines, switchboards, exchanges, insulators, wires, measurements, and expedients for obtaining better service; and on every topic throws a flood of light and gives a variety of useful information that is really remarkable. Generous acknowledgement is made of the writings of such men as Carty, Pickernell, Hibbard and others, but Prof. Hopkins has not satisfied himself with mere quotation, preferring rather to analyze and digest his subject in such a way that each chapter is a well-rounded body of instruction of the matter with which it deals.

The book is illustrated with many cuts, several of which are new, and others of which are essential, and the result is eminently satisfactory. The book is one likely to be of use not only to all engaged in the domain of practical telephony, now broadening so rapidly, but as a college manual and as a basis for lecture courses for students. There are few good books on telephony, and this is certainly one of the best.

Eighth Annual Report of the Board of Gas and Electric Light Commissioners of the Commonwealth of Massachusetts, Boston, January, 1893. (Pub. Doc. No. 35.)

ONE of the most noticeable features of the current annual report of the Massachusetts Commissioners, is the evidence which it gives of a very considerable growth of interest since last year, among the towns and cities of the state in reference to the question of municipal ownership of electric lighting plants. It is true that, so far, only three municipalities have electric plants in actual operation, viz., Danvers, Peabody and Braintree. Wellesley owns a distributing plant, but buys its electricity from a private company, which generates it by water-power. But it appears from recent information that the three first named towns have lately taken measures to add commercial lighting systems to their existing public plants, and in Peabody and Braintree these are nearly ready to go into operation. A considerable number of towns and cities have given consideration to the matter during the past two years, and some of them have formally accepted the provisions of the enabling act of the Legislature of 1891. It is gratifying to notice, however, that the action of the townsmen has, as a rule, been judicious and conservative; but little disposition has been manifested to commit the municipalities to a final course of action in the matter, without careful and thorough consideration, and it is probably safe to predict that in most cases, the decision will depend largely upon the financial outcome of the municipal plants which have been already established. In the abstract, no reason can logically be adduced why commercial electric lighting plants should not be owned and operated by municipalities, that does not equally apply to the ownership of plants for furnishing gas or water. But one obvious and very important practical objection is, that so much more damage may be done, and so much more money can be wasted by ignorance and incompetence, in the construction and operation of an electric plant than is at all possible with a gas or water plant. The statistical returns in the commissioners' report show clearly enough that most of the towns are now being furnished with municipal lights by private companies at nearly cost price, and in some instances at even less than cost; hence we think the taxpayers will act the part of prudence if they decide to take no unnecessary risks. It may be mentioned also, that municipal ownership is much more likely to prove a successful experiment in New England than anywhere else, because the town authorities are compelled to give a yearly account of their stewardship before the whole body of voters, and any mismanagement or waste is pretty sure to be sharply called to account by well-informed critics in the annual town meeting.

The statistical portion of the commissioners' report has already received some consideration in an article recently printed in THE ELECTRICAL ENGINEER. Some of the other figures, however, possess sufficient interest to call for notice. The balance sheets of the electric companies aggregate as follows:—

Assets.	
Construction accounts, cash and materials on hand, bills receivable, etc.............	$12,438,857.19
Liabilities.	
Capital stock, bonds, bills payable, etc.	11,791,890.24
Reserved and depreciation funds.........	132.285.32
	$11,924,715.56
Surplus................................	514,141.63
	$12,438,857.19
Receipts.	
For light and power, and from other sources................................	$2,970,637.94
Expenses.	
For manufacture, distribution and expenses................................	$2,015,402.86
Leaving a balance of net earnings of.....	$955,235.08

The aggregate number of commercial incandescent lamps, according to the returns, is 224,966 as against 161,259 in 1891, and 118,529 in 1890. The returns are made up to June 30, 1892.

We have heretofore called attention to the very defective manner in which the tabulation of the preceding reports has been done. There is no improvement in this respect this pear. Scarcely any aggregate results are given, so that the reader has to laboriously foot up all the figures for himself, if he wishes to obtain any statistical information of value. The form of return required from the companies is also defective in a most important particular, in that it does not call for a statement of the watt-hours of current sent out from each station, so that no conclusions can be reached as to the comparative economy with which the several plants are managed, a comparison which may be made with facility from the returns of the gas companies.

In spite of its shortcomings and omissions, the Massachusetts report is one of the most valuable sources of information accessible, as to the actual results of the operations of a large group of electric lighting and power industries.

PERSONAL.

MR. W. A. KREIDLER, editor and publisher of the *Western Electrician*, was given a complimentary dinner at the Chicago Electric Club a few days ago by 25 of his personal friends. The compliment was a graceful and a deserved one to a man who has spared no effort to promote electrical interests in the West.

OBITUARY.

A. W. MESTON.

MR. A. W. MESTON, Superintendent of the Emerson Electrical Manufacturing Company, St. Louis, died of consumption at his home in St. Louis Friday night, May 12th, after a lingering illness of several months. He had recently returned from a trip to Jamaica in company with Mr. E. J. Bagnall, a trip which had been taken upon the advise of Mr. H. L. Parker, president of the company, and several friends with a view of benefiting his health. But this trip proved to be of little service, for since returning home some five weeks ago he has been confined to his room or bed almost constantly until his death.

Mr. Meston was born near Edinburgh, Scotland, 26 years ago and came to this country at the age of 14. The past eight years he had lived in St. Louis during which time he took a short course in electrical engineering at Washington University. In 1890 he left the University and engaged in the manufacture of electrical apparatus in a small way, in which venture he was associated with his brother Charles R. Meston. This venture resulted in the organization of the Emerson Electric Manufacturing Company in October, 1891, of which he became superintendent and engineer.

Mr. Meston was a deep student in electrical matters. His special study was that of alternating current motors. His work in this field will probably always be recognized as that of a pioneer and resulted in one of the first and most successful alternating current fan motors, which now bears his name. Although never strong in constitution he was always a hard worker, the lights always burning late in his laboratory and room.

Personally he was a most excellent companion, always kind and courteous, yet frank and outspoken with every one. He was a member of the St. Louis Electric Club but owing to his illness he had been unable to take much interest in its active work.

R. J. H.

LETTERS TO THE EDITOR.

THE VALUE OF GRAPHITE AS A LUBRICANT.

In your issue of May 10th, you have an article on Graphite bearings. As we do not manufacture graphite bearings, although we sell graphite to bearing manufacturers, we will have nothing to say about bearings, either pro or con, but, if you will permit, we will have a word or two to say about graphite as a lubricant. You quote from a writer whose acquaintance we would like to make: "Graphite and grease being mixed and put into a bearing the graphite separates itself from the grease and the grease has to do the work, hence nothing is gained." Now, that is too bad, and mean conduct on the part of the graphite. As a matter of fact, however, the conditions are reversed. It is the grease that runs away and leaves the graphite to do the work, but the grease has done its part in conveying the little scales of flake graphite in and between the bearing surfaces, where they form a thin coating of unsurpassed smoothness and wonderful lubricating and cooling power. Dr. Robert Grimshaw, whom your readers know, by reputation at least, says that good dry "air-floated" graphite, free from grit, will cool any hot bearing that anything else will, and will prevent heating better than anything else which he has ever seen.

A fly-wheel shaft-bearing eight inches in diameter and 10 inches long carried a load of nearly 10 tons. This bearing was supported by a box girder, and was lined with good brass. The engine could not be run, as this bearing invariably got nearly red hot after a few revolutions; various oils, tallow, sulphur and gunpowder were tried with most indifferent success. It was determined to have a new crank-shaft with a longer bearing, but as at the last moment the use of graphite and tallow was suggested, the bearing was carefully wiped, and the grease-box on the cap filled with the mixture. The bearing never heated again unless oil was allowed to get access to it. The success of the graphite as a lubricator was perfect. This incident is a valuable practical illustration of the immense utility of graphite, and we could cite hundreds of others.

The writer you quote, further adds: "So far, no genius has been able to discover a way by which the fine lubricating qualities of graphite can be utilized." It looks somewhat as though that writer himself was the genius referred to, but if not, and he is open to conviction, let him write to us and we will send him such a bundle of evidence from practical and able engineers and machinists that he will quickly own that where the "genius" failed practical men found a way. We are also able to offer expert testimony from men of recognized authority in science.

The day has gone by for condemnation of graphite properly prepared. Of course we would not for a moment recommend for lubricating purposes the common commercial plumbago so often sold for such use. We recommend and advocate the water-dressed, air-floated Ticonderoga flake-graphite prepared by the

JOSEPH DIXON CRUCIBLE CO.

JERSEY CITY, N. J., May 19, 1893.

AUTOMATIC WORK ON LONG SUBMARINE CABLES.

WITH the view of promoting historical exactness, I beg to call attention to an article published in THE ELECTRICAL ENGINEER, under date of May 10, describing the Commercial Cable Co.'s exhibit at the World's Fair and in which, among other things, it is stated that "Mr. Wilmot was the first to successfully introduce automatic work on long submarine cables."

If by this assertion it was meant to imply that Mr. Wilmot was the first person who had demonstrated the practicability of operating long-submarine cables by automatic transmission, then the meaning is not in conformity with historical facts. The very first successful automatic transmission over a submarine cable of any considerable length was—as far as is known by the writer—on November 15, 1885, over the cable of the Commercial Cable Company between New York and Canso, Nova Scotia. Transmission was from the company's office in New York through a keyboard automatic transmitter invented by the writer, and the signals, thus automatically transmitted, were recorded at Canso by means of a Thomson siphon recorder. That trial was made in the presence of Mr. Ch. Cuttriss the electrician of the company and of Mr. Paul Hoenack the mechanician who had constructed the transmitter for me, and was a pronounced success.

So impressed were the officials of the company with the importance of the results achieved on that occasion that negotiations looking for a control of the invention were entered into and a trial over the main cable proposed and arranged for. Pursuant to these arrangements, I took the transmitter to the company's station at Waterville, Ireland, then in charge of Mr. Wilmot.

On February 21, 1886, signals were sent over the company's main cable from Waterville through my transmitter and successfully recorded at Canso. Like successful trials were subsequently repeated. From these trials, it is thought, should date the beginning of automatic transmission over long submarine cables. The substitution of the well-known Wheatstone system of perforated paper as an equivalent for my keyboard transmitter was a natural sequence to these trials and only another means to the same end; indeed, during my stay at Waterville, I used a Wheatstone transmitter for the purpose of ascertaining certain important facts in connection with transmission over long cables which up to then had never been determined.

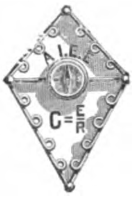
In view of recent developments in cable work it is quite interesting and amusing to recall the learned and dogmatic arguments which were so vehemently urged against the introduction of automatic transmission on cables, even after its entire practicability had been fully demonstrated. It is, however, only another illustration of the short-sightedness of those who cling to old methods because they are familiar with them and who can never discover any good in anything which does not originate with themselves.

Cable telegraphy is no longer at a stand-still and in a few years even the vaunted methods now in vogue will be regarded as crude and antiquated. The siphon recorder, like the mirror, will have to give place to a newer and better form of apparatus and then New Zealand and New York will be in single touch and Puck's "girdle around about the earth" will be a continuous circuit wherein relays will automatically transfer from cable to cable the glorious tidings of the world's continuous progress, and tell it to the ear and eye in a new and unmistakable manner.

CHARLES G. BURKE.

BROOKLYN, N. Y., May 12, 1893.

THE A. I. E. E. OFFICIAL BADGE AND CERTIFICATE.



THE Committee on Badge and Certificate, of the Institute has concluded its labors and the new badges are now ready for delivery, most of the members attending the annual meeting having already secured them. The accompanying illustration shows the badge in full size, and the following interpretation of its symbolic features is given by the committee, consisting of Messrs. F. Benedict Herzog, Horatio A. Foster, and Wm. J. Hammer.

Franklin's kite which demonstrated the identity between lightning and electricity, and represents static electricity. It is a recognition of America's first electrician and philosopher, Benjamin Franklin.

A diagramatic representation of Wheatstone's Bridge, one of the most important pieces of electrical testing apparatus.

The galvanometer, another equally important piece of testing apparatus and which represents magnetism and induction.

The amber, of which the galvanometer is made represents the first conception of electricity dating back to 600 years B. C., when Thales, the Greek philosopher, recorded the fact that amber, when rubbed, attracted light particles to it, and the Greeks worshipped it, believing the gods had endowed it with life and that it possessed a soul.

In 1600 A. D., Dr. Gilbert, court physician to Queen Elizabeth, coined the world electricity from the word electron, the Greek name for amber.

A. I. E. E. represent the initials of the American Institute of Electrical Engineers.

$C = \frac{E.}{R.}$ represents Ohm's Law—a fundamental law in electrical work.

The pin is made of white enamel with the lettering and front portions in 18 karat gold and the back in 14 karat gold. It can be obtained of the secretary, Ralph W. Pope, 12 W. 31st street, New York. Price, $3.

The certificates of membership will also be ready for distribution at an early day.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED MAY 16, 1893.

Conductors, Conduits and Insulators :—

Process of Making Mica Insulating Plates, C. W. Jefferson, Schenectady, N. Y., 497,324. Filed Feb. 15, 1893.

Improvement in the process shown in patents Nos. 483,646 and 483,653 of Oct. 4, 1892; and 491,707 and 491,706 of Feb. 14, 1893. Plates formed of mica sheets and cement.

Insulating Tape, W. R. Patterson, Chicago, Ill., 497,336. Filed Aug. 24, 1891.

Relates to paper tape for insulating the wires of cables. The tape is corrugated transversely along its middle, and when wound spirally around a wire buckles upon one or more interior lines forming helical ridges; thus leaving opportunity for air spaces between adjoining wires so covered.

Insulator, T. H. Brady, New Britain, Conn., 497,515. Filed Jan. 16, 1893.

Improvement in insulator knobs and clips.

Process of Manufacturing Electric Conduit Sections, J. F. Cummings, Detroit, Michigan, 497,535. Filed July 12, 1892.

Employs two concentric tubes with blocks between them forming spaces from end to end and then forces a non-conducting compound into the annular spaces.

Underground Conduit for Electrical Conductors, J. F. Cummings, Detroit, Mich., 597,536. Filed July 28, 1892.

Similar to the next above with added features relating to joints and manholes.

Junction Box. J. J. Powers and R. Van Buren, Brooklyn, N. Y., 497,601. Filed Dec. 27, 1892.

For electrical conduits.

Distribution :—

System of Electrical Distribution, W. Meissner, Konigsberg, Germany, 497,755. Filed Oct. 23, 1889.

Claim 1 follows:

In a system of electrical distribution the combination of main conductors, an electric generator connected to said main conductors, groups of translating devices arranged in parallel series between said main conductors, intermediate conductors between the groups, and compensating generators directly connected by one terminal to one of the main conductors as a common conductor, and having their other terminals individually connected to one of the other conductors, substantially as described, in such a way as to maintain constant potential in the various groups of devices, irrespective of their load.

Dynamos and Motors :—

Commutator Brush Holder for Dynamo Electric Machines, E. Thomson, Swampscott, Mass., 497,361. Filed Nov. 2, 1891.

Adapted to a holder for carbon brushes, and employs a fluid-pressure device for maintaining uniformity of contact.

Dynamo Electric Machine or Motor, W. K. Freeman, Boston, Mass., 497,468. Filed Nov. 3, 1892.

Relates to design and construction.

Armature Core for Electric Motors. J. E. Stuart and U. S. James, Helena, Mont., 497,504. Filed Oct. 24, 1892.

Designed to secure easy and economical winding and thorough ventilation.

Electrolysis :—

Process of Electro-Tin-Plating, L. Aronson, New York, N. Y., 497,621. Filed Jan. 31, 1893.

Lamps and Appurtenances :—

Arc Electric Lamp, J. C. Wray, Peoria, Ill., 497,438. Filed Mar. 21, 1892.

Regulating device for a solenoid lamp.

Electric Arc Lamp, R. M. Hunter, Philadelphia, Pa., 497,450. Filed Sept. 22, 1892.

Relates particularly to arc lamps for use on incandescent circuits.

Automatic Cut-Out for Electric Light Circuits, C. Cuno, Wauwatosa, Wis., 497,491. Filed April 16, 1892.

Designed to cut off a customer's supply of current when he uses more lamps than he pays for.

Electric Arc Lamp, J. Einstein, Munich, Germany, 497,494. Filed Nov. 23, 1892.

Regulating device.

Electric Arc Lamp, F. H. Thomson, Philadelphia, Pa., 497,558. Filed Jan. 19, 1892.

Relates to a bushing, forming contact with the carbon rod and serving also as a guide.

Circuit Switch. E. Woltmann and H. A. Triggs, Denver, Colo., 497,756. Filed Jan. 17, 1893.

Especially designed for electric light circuits.

Measurement :—

Galvanometer, A. H. Hoyt, Manchester, N. H., 497,448. Filed May 9, 1892.

Employs a permanent magnet and a solenoid magnet. The solenoid is provided with an adjustable core to vary its effect on the needle.

Galvanometer, A. H. Hoyt, Manchester, N. H., 497,449. Filed May, 9, 1892.

Especially adapted for measuring strong currents.

Electric Measuring Instrument, A. H. Hoyt, Manchester, N. H., 497,521. Filed Nov. 14, 1891.

Comprises a field-magnet and an indicating armature or needle pivoted in the field and a bridge or keeper connecting the poles of the field magnet and modifying its effect upon the needle.

Galvanometer, A. H. Hoyt, Manchester, N. H., 497,522. Filed Nov. 14, 1891.

Similar to the above.

Electrical Measuring Instrument, O. Frolich, Berlin, Germany, 497,539. Filed Oct. 25, 1892.

Metallurgical :—

Amalgamator for Gold or Silver Ores, A. B. Kittson, Boston, Mass., 497,669. Filed Nov. 4, 1892.

Employs an electric current passing through the unbroken body of mercury between the rollers to facilitate the process.

Miscellaneous :—

Automatic Disconnector, W. A. Cullen, Paterson, N. J., 497,310. Filed Jan. 28, 1893.

Passage of current automatically discontinued in case of breakage or short-circuiting of conducting wire.

Automatic Time-Stamp, W. B. Martindale, Rochester, Ind. 497,331. Filed June 30, 1892.

Employs electro-magnetic controlling device.

Rheostat, P. Wright, Denver, Colo., 497,366. Filed Jan. 16, 1862.

Employs a thin piece of metal folded back and forth upon itself with insulating material between the folds.

Lightning Arrester, A. J. Wurts and C. F. Scott, Pittsburgh, Pa., 497,397. Filed Oct 26, 1892.

For protecting motors and generators. An improvement on the invention shown in the patent of A. J. Wurts, 476,855, June 14, 1892.

Electric Cigar Lighter, J. P. Carstarphen, Jr., Denver, Colo., 497,404. Filed Aug. 17, 1892.

Push-Button Switch, F. S. McGregory, Revere, Mass., 497,411. Filed Jan. 21, 1893.

Circuit Protector, H. W. Leland, Jersey City, N. J., 497,430. Filed Aug. 6, 1892.

To protect front-door push-buttons and the like from thieves.

Wire Hanger, A. J. Wylie, Rome, N. Y., 497,439. Filed Oct. 14, 1892.

Shunt for Electric Light and Power Stations, E. Weston, Newark, N. J., 497,482. Filed Nov. 28, 1892.

Relates to a permanent shunt to be placed in the main circuit of a light or power plant, and to be connected with a measuring instrument, so that a portion of the current of known difference of potential may be conducted to the measuring instrument.

Circuit Controlling Device, J. P. Buchanan, Boston, Mass., 497,489. Filed Oct. 15, 1891.

For controlling the admission and withholding of current from translating devices with certainty. Specially adapted to railway signals.

Electric Rink, M. W. Hassan, Rochester, N. Y., 497,495. Filed May 28, 1891.

A substitute for roller-skating, adapted for the use of the lazy.

Lightning Arrester, A. J. Wurts, Pittsburgh, Pa., 497,507. Filed Dec. 22, 1892.

For protection of dynamos, motors, etc. Employs a so-called "artificial ground," insulated from the earth sufficiently to prevent the passage of currents of ordinary potential, connected electrically to the line.

Lightning Arrester, A. J. Wurts, Pittsburgh, Pa, 497,508. Filed Dec. 22, 1892.

Claim 1 follows:

As a means for protecting an all-metal circuit from atmospheric electricity, a lightning arrester connected to one leg of the circuit and a condenser having its opposite plates connected respectively with the two legs of said circuit.

Lightning Arrester, A. J. Wurts, Pittsburgh, Pa., 497,509. Filed Dec. 22, 1892.

Employs a branch line of high resistance, between the main line and ground, and a condenser in the branch line, together with permanent means for causing leakage of static charge from the condenser.

Device for Illuminating Gun Sights by Electricity, G. Di Giovanni, Turin, Italy, 497,540. Filed Sept. 19, 1892.

Employs an incandescent lamp and a suitable generator mounted on the gun near the sight.

System of Conductors for Electric Fire Engines, J. Sachs, New York, N. Y., 497,552. Filed May 26, 1892.

Relates especially to means for conveniently joining terminals to supply conductors at any desired point.

Electric Pump Governor, C. R. Whittier, New York, N. Y., 497,563. Filed Aug. 8, 1892.

Electro-mechanical means for stopping and starting, controlled by the pressure in the discharge pipe.

Safety Cut-Out Apparatus for Networks of Multiple Electrical Conductors, P. Nordmann, Berlin, Germany, 497,680. Filed Nov. 25, 1892.

Relates to means for automatically breaking all the circuits of a multiple conductor system when the current in any one exceeds a predetermined amount.

Binding Post Fuse, S. M. Stupakoff, Pittsburgh, Pa., 497,732. Filed Sept. 5, 1892.

Railways and Appliances :—

Overhead Electric Railway, W. D. Patterson, Keokuk, Ia., 497,337. Filed Nov. 1, 1892.

Employs a trolley running upon the top of the trolley wire and supported upon a telescoping arm.

Electric Car Truck, G. S. Strong, New York, N. Y., 497,356. Filed Jan. 25, 1892.

Relates to the construction of the truck and its combination with the motor.

Trolley for Conduit Railways, P. C. Just, Chicago, Ill., 497,377. Filed April 20, 1892.

Adapted to change position readily with reference to the vertical plane of its support.

Conduit Electric Railway, G. Westinghouse, Jr., Pittsburgh, Pa., 497,394. Filed April 8, 1892.

Conduit is constructed with two longitudinal compartments, the lower of which is for drainage and the upper for containing the conductor. The conductor, which may be in the form of a pipe or rod of iron or other suitable metal, is jointed in such a manner as to permit expansion and contraction through changes of temperature without affecting its alignment.

Electric Railway Signal, W. H. Jordan, Brooklyn, N. Y., 497,408. Filed Sept. 10, 1892.

For displaying signals at road crossings and similar places, illuminated or otherwise.

Sectional Contact Conductor for Electric Railways, G. Westinghouse, Jr., Pittsburgh, Pa., 497,436. Filed April 11, 1892.

Relates to the construction of circuit controllers for use in connection with a system employing a main general supply conductor and sectional conductors insulated from each other.

Closed Conduit for electric Railways, A. J. Martin, Philadelphia, Pa., 497,585. Filed Sept. 13, 1892.

Claim 1 follows:

In an electrical railway a tube made in longitudinal sections having its conducting section insulated from the other section, and having conducting stems passing from the conducting section through the other section, and provided with metal track slips on the outside of the tube.

Telephones and Apparatus :—

Magneto Telephone, J. P. Freeman, Washington, D. C., 497,649. Filed May 16, 1892.

CHARGES AGAINST EX-COMMISSIONER SIMONDS AND THE BELL ATTORNIES.

FORMAL charges have been made against Mr. W. E. Simonds, the late Commissioner of Patents, and Foster & Freeman, the American Bell Telephone attornies in Washington, alleging improper inspection of the secret files in the Drawbaugh telephone cases, and the unlawful taking of copies thereof, for the private use of Mr. Simonds and the Bell people. Chief clerk Bennett, of the Patent Office, is also included in the matter. The charges are brought by Drawbaugh's attornies, Church & Church, who ask for an investigation and for the disbarment of Messrs. Simonds, Foster and Freeman. The charges relate to certain applications still pending for patents, the allegation being that copies of the documents and of other papers have been freely made and given out.

Mr. Simonds says that he has done nothing improper, and that there is no law or rule to prevent anything being kept from the public except the caveats. It is, he says, entirely within the discretion of the Commissioner whether permission to copy such applications be granted. It is claimed that the question was settled some time ago by Judge Lacombe in an electric light case between the Edison and United States interests.

SOCIETY AND CLUB NOTES.

ANNUAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE annual meeting of the Institute, according to announcement, convened at 4 p. m., on Tuesday, May 16, President Frank J. Sprague in the chair. This session was devoted to the transaction of the business affairs of the Institute, the reading of the reports of the treasurer and secretary, etc.

The counting of the ballots for officers for the ensuing year was then proceeded with, and resulted in the election of the following officers:—President, Prof. Edwin J. Houston; vice-presidents (for 2 years), Messrs. H. Ward Leonard, P. B. Delany, and William Wallace; managers (for 3 years), Messrs. Ch. Hewitt, Harris J. Ryan, Wm. J. Hammer, and J. J. Carty; treasurer, Mr. Geo. M. Phelps.

After the announcement of the vote, the members adjourned to the "Arena" restaurant where the annual dinner was served. The newly elected president, Prof. Houston, presided, and Mr. Frank J. Sprague acted as toast master. Various toasts were responded to by Messrs. T. D. Lockwood, Ch. E. Emery, E. G. Willyoung and T. Commerford Martin.

On the morning of the following day, the reading and discussion of papers was taken up and continued until close upon 4 o'clock. The members then adjourned in a body to Columbia College, to listen to the paper of Dr. M. I. Pupin, on "Practical Aspects of Electrical Resonance." This was accompanied by a number of beautiful experiments illustrating the powerful influence of resonance in increasing the E. M. F. in induced circuits, and some peculiar properties of iron.

In the evening the members again assembled at Columbia College as the guests of the New York Electrical Society, to listen to the lecture by Dr. Wm. J. Morton, on "A Glance at Electricity in Medicine," which was accompanied by practical demonstrations with the aid of a very fine Holtz-Wimshurst static influence machine. Mr. W. J. Jenks kindly assisted in the role of a supposed patient undergoing electro-therapeutic treatment with the methods which Dr. Morton employs.

On Friday afternoon a special train took a large party to the works of the Crocker-Wheeler Electric Company, at Ampere, N. J., where the members were afforded ample opportunity for inspecting the latest development in the application of electric motive power to the driving of machinery directly without the intermediary of countershafting. The methods employed in the Crocker-Wheeler works have already been described in our columns. Nearly 100 members, with ladies and friends, availed themselves of the special train. At the close of the two hours' inspection, the members assembled at the office building, and on the suggestion of vice-president Leonard gave three resounding cheers for the Crocker-Wheeler Company.

PROF. E. J. HOUSTON.

PROF. E. J. HOUSTON,

President, American Institute Electrical Engineers.

THE new, and ninth, president of the American Institute of Electrical Engineers, Prof. E. J. Houston, is a man well known to every electrician, by his inventions and writings, and personally to a great many who will recognize the striking fidelity of the portrait given on this page, taken from a recent photograph. Prof. Houston comes of an old and distinguished Pennsylvanian family, and his life work has been almost wholly done in Philadelphia, where for many years past he has been the Professor of Physics at the High School—a position which his love of educational work has led him to retain in spite of a multiplicity of other calls and duties. It was at the High School that he and his younger associate, Prof. Elihu Thomson, did so much of the work in electric lighting that first made both their names famous and that gave to the world the all-conquering Thomson-Houston arc system. Of late years, Prof. Houston has devoted himself to literary pursuits, producing a great many books, of which his "Electrical Dictionary" is perhaps the most popular. It is by no means on electricity, however, that all his best books have been written, as his Geography is a standard in large use, and his "Outlines of Forestry," just issued, bids fair to become useful far and wide in spreading a knowledge of tree culture and forest preservation.

Prof. Houston is a man of generous, catholic tastes. He loves old books and new ideas. He stimulates the ambition of his students with the story of all the Philadelphia worthies of the past, and himself sets them a laudable example of tireless industry. Nor is he altogether a pedant and bookworm. He is the active president of the Schuylkill Navy, at whose fine club house he may often be seen, either sprinting on the tan bark or ruling amiably over a professional bout with the gloves.

The interest taken by Prof. Houston in the International Electrical Exhibition at Philadelphia, in 1884, is well remembered. He was its electrician, and did much to render it a success. As one of the oldest officers of the Franklin Institute, he is foremost in efforts to promote its influence and prosperity. He is greatly interested in the success of the Chicago Electrical Congress; and may be depended upon to do all that his long experience and his enthusiasm can suggest to advance the welfare of the Institute of Electrical Engineers during his very important term of office.

MASSACHUSETTS MECHANICAL AND ELECTRICAL ASSOCIATION.

AT the last meeting of the Massachusetts Mechanical and Electrical Association, a paper was read by Mr. G. H. Almon, on the Cause of Atmospheric Electricity, and the Principle of Lightning Arresters and their Application to Electric Light and Telephone Lines.

The paper showed that it had been prepared very carefully, and it proved very instructive to the Association.

NEW YORK ELECTRICAL SOCIETY.—A LECTURE ON ELECTRO-THERAPEUTICS.

THE closing meeting of the season of the New York Electrical Society was held at Columbia College on the 17th inst. The subject of the evening was, "A Brief Glance at Electricity in Medicine," by Dr. W. J. Morton, professor of diseases of the mind, nervous diseases and electrotherapeutics at the New York Post Graduate Medical School and Hospital. There was a large audience, the attendance of members of the Society being supplemented by a contingent of the American Institute of Electrical Engineers, and the New York Electrotherapeutic Association, who had been specially invited to attend.

Although Dr. Morton disclaimed any ability to treat the subject of the application of electricity to medicine adequately in the time at his disposal, his facts were so well marshalled and his scientific deductions so lucidly drawn, that his paper, which was listened to with absorbing interest, defined, in clear outline, the best results of the most earnest labor in electrotherapeutic fields during the last half century. It is safe to say that a more thorough and at the same time more original public contribution to the general subject of electrotherapy has never been made.

The introduction of the lecture was devoted to a concise description of the effects of the three conventional currents in medical use, galvanism, faradism and franklinism, which give results of specific difference, physically and physiologically, when applied to the human organism. Their physical properties were given as heat, light, magnetic induction, chemical-electrolytic, and cataphoric; and their physiological properties as contraction of protoplasm, excitation of nerve and muscle and electrotonus. Many of the most important services of the electric current are the result of its chemical or electrolytic properties. The human body for practical purposes of the administration of electricity may be considered as a semi-fluid mass, whose conducting power is due to its salts, held in solution. This solution, equal to about a two per cent. solution of common salt, enables electrolysis, or chemical decomposition and cataphoresis, or electric transfer of fluids, to attain marvelous results. Gautier, of Paris, has done inestimable service to medical science by his developments in metallic electrolysis, the rationale of which is quickly seen. An iron needle connected to the positive pole, plunged into human tissue, is quickly attacked by the oxygen and chlorine set free at this pole. It is then converted into oxychloride of iron, a double salt, and is soon completely destroyed. The same is true of any metal attacked by oxygen or chlorine. A copper needle or bulb, or other conveniently-shaped electrode is converted, into oxychloride of copper, zinc into oxychloride of zinc, and so on. Dr. Morton holds the opinion that this method has before it a brilliant future. In gynæcological work, in nasal catarrh, ozœna, unhealthy ulcerations and discharging cavities, it produces antiseptic and healing effects attainable by no other means. Its effects in catarrh are simply magical, and it is much to be regretted that the exigencies of medical etiquette have hitherto restricted to the medical profession the knowledge of this wonderful remedy for one of the curses of this country. The ability to secure the best results of cataphoric and electrolytic medication is at present vested, unfortunately, in a limited number of practitioners, but there can be little doubt that eventually its adoption will become universal, as the process, in skillful hands, is capable of effecting a certain, quick, safe and almost painless cure.

A considerable part of the lecture was devoted to the consideration of the high frequency, high-potential currents of Tesla, Morton and D'Arsonval. Dr. Morton pointed out that with an electrostatic machine nearly all the Tesla effects could be produced, and some beautiful illustrations of the "Tesla glow" were given to the audience by its means. Dr. Morton looks upon this machine as a medium of electric generation whose capabilities have not yet been appreciated either by electricians or physicians. To D'Arsonval, of Paris, was accorded the credit of the development of the physiological, as apart from the physical, effects of the high potential, high-frequency current. He systematized its data and expended upon it a vast amount of original research, while to Gautier and Larat we are indebted for the promulgation of the sinusoidal current in its medical application. It is not generally known that Dr. Morton, who studied in Paris with Prof. Charcot in 1880, was the first to introduce into this country the new application of static electricity in medicine, and read a paper on the subject before the New York Academy of Medicine, March 3, 1881. In that publication he described a method of obtaining high potential, high-frequency currents from the influence machine, and pointed out its use and value in therapeutic work, under the title of "A New Induction Current in Medical Electricity." The current was named the "Static-Induced Current." It attracted but little attention, cognizance of it being confined to medical circles, and moreover it was not generally comprehended. It is interesting to recall these facts now that the splendid developments of Tesla have made known to the world the possibilities of high frequency, high-potential currents, and, moreover, that the value of the Morton current has come to be recognized as an electrotherapeutic agency.

OFFICIAL APPOINTMENTS TO THE ELECTRICAL CONGRESS.

WE have received the following communication from Dr. Elisha Gray, president of the Advisory Council of the Chicago World's Congress of Electricians:—

Editor, THE ELECTRICAL ENGINEER,
203 Broadway, New York, N. Y.

Dear Sir:—We have the pleasure to announce, that in accordance with the expressed wish of the American Branch of the Advisory Council of the World's Congress of Electricians, the Secretary of State has appointed

Prof. H. A. Rowland, Johns Hopkins University;
Prof. T. C. Mendenhall, Superintendent of Standard Weights and Measures;
Prof. H. S. Carhart, Michigan University;
Prof. Elihu Thomson, Lynn, Mass., and
Prof. E. S. Nichols, Cornell University,

to sit in the Chamber of Delegates as the duly authorized United States Delegates.

While there are many electricians in the United States who could fill with dignity and credit to the profession this honorable and responsible position, yet the profession is to be specially congratulated that the United States is to be represented by men of such high standing both as gentlemen and members of the profession.

We also have the pleasure to announce that the Royal Commission has named W. H. Preece, Prof. S. P. Thompson, Prof. W. E. Ayrton, Major Cardew and Alexander Siemens as Delegates from Great Britain.

There is every reason to believe that the success of the Congress is now assured, and that all the important countries will be fairly represented.

Sincerely yours,
ELISHA GRAY, *Chairman*,
World's Electrical Congress Committee.

HIGHLAND PARK, ILL., May 16, 1893.

LEGAL NOTES.

THE McKEESPORT TELEPHONE SUIT.

THE suit of the American Bell Telephone Co. against the McKeesport Telephone Co., operating the Shaver telephone system at McKeesport, Pa., came up for hearing on May 22. Among the defendants' affidavits to oppose the motion for a preliminary injunction is one by Dr. Park Benjamin, the well-known electrical expert.

In his affidavit Dr. Benjamin analyzes the claims of the second Bell patent, No. 186,787 of January 30, 1877, and shows how any skilled mechanic, with the first patent of Bell before him, and in the light of scientific facts then well known, could have made the form of telephone described in Bell's second patent, and that hence it involved no invention. The employment of a permanent magnet with a coil at one end (the Schellen magnet) had been used in the Hughes printing telegraph described in Du Moncel's *Traité Théoretique et Pratique de Télégraphie Electrique*, Paris, 1864. Reference is also made to the work of Nickles in *Les Electro Aimants*, published in Paris, in 1860, and the affidavit embraces a reproduction of a sheet of drawing taken from that work, showing various types of magnets which, if substituted for the Bell magnet, would have operated in the same way.

This affidavit is supported by others, by Dr. M. I. Pupin, Stephen D. Field, Prof. F. B. Crocker and George F. Shaver, all of whom corroborate the opinions of Dr. Benjamin.

THE OCONTO, WIS., LAMP LITIGATION.

THE EDISON COMPANY and the Electric Manufacturing Co. of Oconto, Wis., went before Judge Seaman, in Chicago, on May 19, in his chambers, on a motion of the latter to set aside the restraining order, but were stood off for one week from May 22, owing to the fact that the judge could not possibly find time for the hearing, as his jury was waiting for him to try other cases.

THE GOEBEL CASE IN ST. LOUIS.

THE EDISON ELECTRIC LIGHT COMPANY has made a motion to the effect that the $20,000 bond of the Columbia Incandescent Lamp Company, fixed under the recent decision of Judge Hallett, is too small, and that it should be increased.

THE U. S. SUPREME COURT has denied the Sawyer-Man Company's motion, for its special intervention against the Edison Electric Light Company, as cited in THE ELECTRICAL ENGINEER last week.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

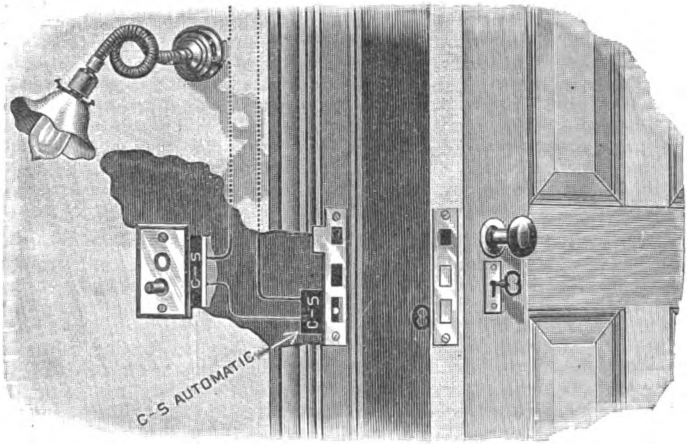
A NOVEL APPLICATION OF THE C-S AUTOMATIC SWITCH.

IN the accompanying cut we illustrate a novel application of the C-S automatic switch, the action of which was fully described in one of our recent issues, wherein it is so arranged as to arbitrarily cut out the current from a hotel guest-chamber by the process of locking the door from the outside.

It is probable that no other hotel expense is so greatly augmented by the negligence of guests as is that attendant upon lighting the rooms, and this is particularly the case where the electric light is used. Indeed it is estimated that ninety per cent. of all hotel guests invariably leave their lights burning upon vacating their rooms.

The evil has become so general, and has proved to be such an immense drain upon business revenue, that hotel managers are constantly trying to devise a remedy, but thus far the only safeguard seems to be to have a constant watch kept upon all the rooms; a method at once expensive and inconvenient. It is the province of this novel application of the "C-S Automatic" to compel the guest to turn off his light upon leaving his room whether it occurs to him to do so or not.

In the modern hotel it is the practice to fit the doors of all guest chambers with "secret" or double bolt locks, one bolt being operated from the inside, the other from the outside, and it is by taking advantage of this arrangement that the C-S switch is made to perform this service of economy in a most successful manner.



APPLICATION OF THE C-S AUTOMATIC SWITCH.

As is shown in the cut, a "C-S Automatic" is placed in the moulding of the door-jamb immediately back of the striker plate in such a manner that the "push" of the switch is directly in line with the movement of the bolt that is operated from the outside of the door. With this arrangement, it will be understood that, when in the process of locking the door from the *outside*, the bolt is thrown, it engages with the switch-push, thus "opening" the switch and turning off the lights, while locking the door from the *inside* has no effect whatever upon the action of the switch.

However, to provide means whereby the occupant of the room may turn the light off from the inside where desired, an auxiliary switch is placed on the inside of the room, in circuit between the controlling door lock and the lamps, in such manner that while the door remains unlocked upon the outside, the lamps may be turned on or off at will in the usual manner; but whatever the position of this auxiliary switch may be, as to whether the current is "off" or "on," when the occupant locks his door from the outside upon leaving the room the lights are invariably turned off.

This unique and valuable device is a recent addition to the well known line of C-S specialties manufactured by The Cutter Electrical Manufacturing Company, of Philadelphia. Although comparatively new, they have already been placed in all the rooms of the Great Northern Hotel, Chicago; and other well known hotels are now being fitted with them.

STILL ANOTHER.

HERBERT W. HARRIS, formerly of the *Electrical World*, has bought from Egbert P. Watson a half interest in the *Engineer* (a steam engineering paper), New York, and will be identified in its management and publication.—*American Stationer.*

NEFTEL & MARSH RAILWAY CONTRACTS.

A RUSH of good work is reported by Neftel & Marsh Company, of 126 Liberty street, who in addition to contracts already reported by us have secured the order for the construction of the Delaware County and Philadelphia Railway, and the Moyamensing and Penrose Ferry Passenger Railway, both of Philadelphia.

NEW YORK NOTES.

THE SUBURBAN UNDERWRITERS' ASSOCIATION OF NEW YORK STATE has recently made an extension of its territory by having transferred from the Middle Department of Underwriters the following territory of New Jersey:—Essex, Union, Middlesex, Bergen, Morris, Sussex, Passaic, Somerset, Warren and Hunterdon counties. This Association has adopted the revised and codified rules of the Underwriters' International Electric Association, and it will be of interest for electric light companies, contractors, and others, to send to the Association's office, No. 44 Pine street, New York City, for copies of rules and regulations. This new territory will be looked after by their consulting electrician, Mr. Fremont Wilson.

THE STIRLING COMPANY, manufacturers of water tube boilers, 74 Cortlandt street, New York, have recently closed the following orders: Cleveland Cable Railway Company, 750 h. p.; Lehigh Valley Traction Company, 900 h. p.; Whitman & Barens for their New Chicago Works, 1,000 h. p.; Elmira Knitting Mills, 50 h. p. We are also installing a plant for the Union Passenger Railway Company of New York City, and for the Lindell Avenue Railroad, St. Louis, Mo. The latter plant, being for 2,600 h. p. The New York office of the Stirling Company, will, in the future be managed by Mr. F. A. Scheffler; and by carefully bearing customers' interests in mind the company trust that business in this section of the country, will be largely increased.

MR. JOHN R. COFFMAN, the representative of the Eureka Tempered Copper Company, of North East, Pa., was in New York last week to close up some important contracts for tempered copper pieces. The company are now turning out their product in a greater variety of shapes and sizes than ever, and some of their bars are of enormous dimensions and weight, indicative of the rapidly growing proportions of dynamos and motors.

THE COMMERCIAL CABLE COMPANY write us:—"The Commercial Cable Company was the first to give Scotland direct communication with America. It established an office at Glasgow before any other company. It has now opened an additional office there, with a view of giving greater cabling facilities to grain merchants and others in the immediate vicinity of the Corn Exchange."

A. O. SCHOONMAKER, 158 William street, New York, is a large importer of East India mica. He offers it to the trade in the solid sheet form, which he claims is superior for all insulating purposes to any of the manufactured articles that are now being offered to the trade as substitutes. He can supply it in uncut sheets, or cut to sizes or cut to any pattern desired.

PORTER BROS. & CO., 78 and 80 Worth street, this city, who make large quantities of buttons, have also made a great many varieties of insulated parts for incandescent lamp sockets, etc., using their material which is a pretty key, with hard, clean finish, and appears to make an excellent insulation for inside detail.

THE INTERNATIONAL TRADING AND ELECTRIC COMPANY, W. H. Fleming, general manager, has removed from the Times Building to 40 Cortlandt street, in order to be better situated for meeting electrical people. It will have larger facilities for handling its increased export trade in electrical goods.

W. R. OSTRANDER & CO. have removed to 204 Fulton street, nearly opposite their old place. They have opened up in their new quarters with a fine stock of their electric house-furnishing goods and bell-hangers' hardware.

MR. P. C. BURNS, of the Laclede Carbon Electric Company of Peru, Ind., was in town last week, and reported that on his trip eastward he secured a large number of orders for his Genuine Laclede and Hercules batteries.

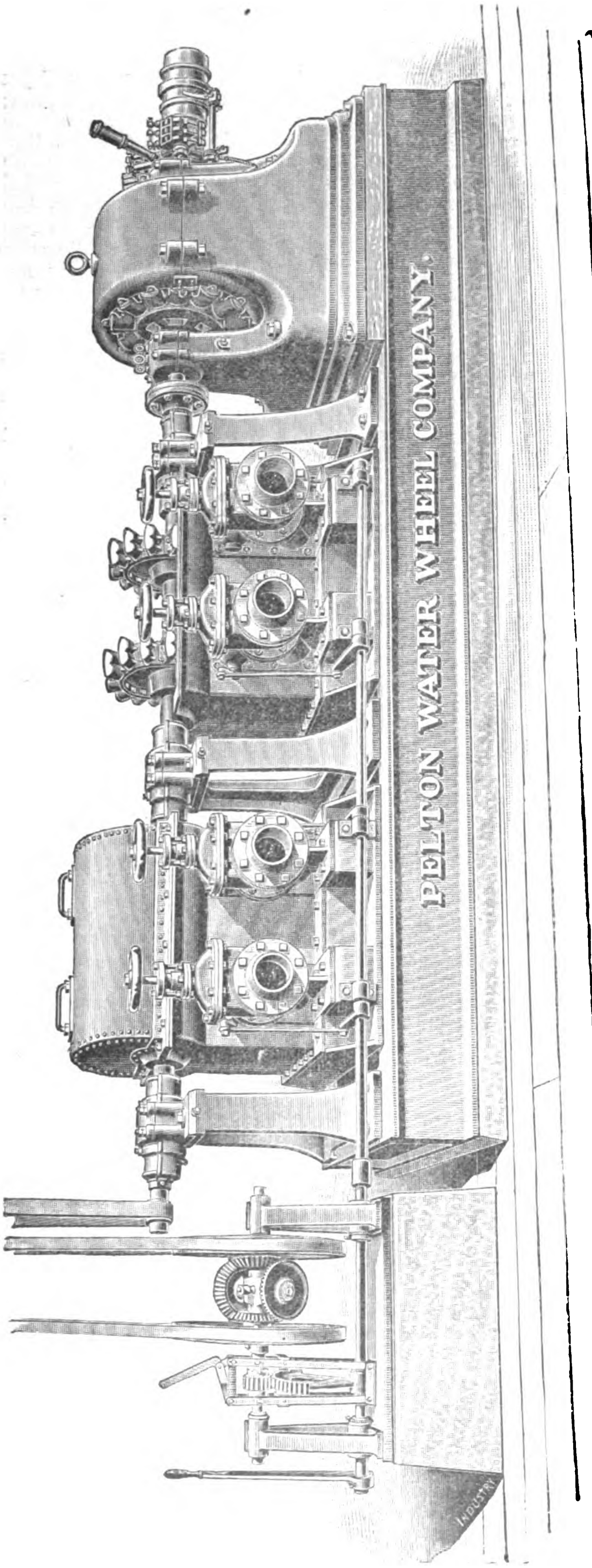
MR. C. A. SHEEHAN has been appointed general advertising agent of the passenger department of the West Shore Railroad, with headquarters at 5 Vanderbilt avenue, Forty-second street, this city.

MR. E. C. FRENCH, representing the Babcock & Wilcox Co., of 30 Cortlandt street, has established an agency at Deseronto, Ontario, Canada.

THE AMERICAN STREET RAILWAY ASSOCIATION does not begin its convention in Milwaukee until October 18, but the Exposition Building, for the exhibit has been secured from October 9 until October 23.

THE PELTON DIFFERENTIAL AUTOMATIC WATERWHEEL GOVERNOR.

THE accompanying engraving shows an application of Pelton wheels to electric generators by direct connection to the armature shaft. The wheels, four in number, are mounted on one shaft and connected to the generator shaft by an insulated coupling. They are 21 inches in diameter and have a combined capacity of 250 h. p., with a speed of 360 revolutions per minute under a running head of 340 feet. The power from this station is carried 16 miles and is used for general mining purposes. The wheels in the plant here referred to required to be of this small diameter to give proper speed to the generator under the head available in this case. A slower speed generator or a higher head of water would have admitted of larger wheels and consequently a less number to give the same power.



PELTON WATER WHEELS WITH DIFFERENTIAL AUTOMATIC GOVERNOR, DRIVING ALTERNATORS DIRECT.

The application here shown illustrates the extreme flexibility of the Pelton power system and the facility with which adaptation can be made to all varying condition. Reference may also be made to the superior character of the work as well as the excellence of design presented, which conforms to the best modern practice in this class of machinery.

The Pelton differential automatic governor, shown on the left of the cut, insures absolute and most sensitive control, maintaining a uniform speed on the wheel with instant and wide variations of load, and affords the means of operating electric machinery by water power with absolute security and satisfaction.

THE PENTZ-RECKENZAUN ELECTRIC METER.

ON page 500 of this issue our readers will find a thorough description of this meter given by its inventors. The new instrument marks an important advance in this direction, and the experience of many months has shown it to fulfil in every way the requirements of a meter that shall be fair both to the consumer and the operating company. The manufacture of these meters is now being actively pushed by the Pentz-Reckenzaun Electric Co., whose offices are at 1001 Chestnut street, Philadelphia, Pa.

PHILADELPHIA NOTES.

THE PHILADELPHIA ENGINEERING WORKS, Limited, have contracted with the Poughkeepsie Iron Company, Poughkeepsie, N. Y., for a complete blast furnace plant at Poughkeepsie, N. Y. The plant will be equipped with three 19 x 60-foot Gordon, Whitwell-Cowper fire-brick hot blast stoves, three Corliss valve, horizontal blowing engines, 84-inch diameter of blast cylinder, 50-inch diameter of steam cylinder, 72-inch stroke, of their latest patterns and designs, 1,200 h. p. of Stirling water tube boilers, and all the pumps and piping necessary for the plant. The whole work will require about one million fire-brick the orders for which have been placed with Mr. C. N. Christie, of Poughkeepsie, N. Y., and Mr. John B. Marie, of this city. The plant is to be completed and ready for operation the latter part of October.

THE TANNITE PULLEY COVERING COMPANY, of 18 South Broad street, are making quite a success of their patent pulley covering, which is intended to prevent slip of belting, and yet enables the belt to be run slacker without any loss of power. The writer has seen it in very successful use on the dynamos and pulleys of the *Daily News* here, the tannite shell appearing to make an excellent pulley face, with all the gain in power claimed for it. Mr. J. Stewart Knight, the lumberman, is actively interested in this device, as also Mr. J. T. Fewkes of the Thackara Manufacturing Company.

MR. CHAS. RUSSELL, who is well-known in Philadelphia, has become the general sales agent for the Duplex Electric Company, Limited, of Corry, Pa. He will have his headquarters at Corry, and will also look after their engineering and construction department. The company, with his help, will push more actively than ever the manufacture and sale of their arc and incandescent dynamos and arc lamps.

MR. W. N. MARCUS, of 218 North Second street, Philadelphia, is introducing a number of useful telephone novelties, including his auxiliary mouthpiece for telephones, which has already made many friends. He will exhibit at the World's Fair in Y 12. This mouthpiece rotates, and the orifice can thus be brought to the level of persons of any stature. There is not the slightest loss of sound.

ELISHA B. SEELEY & CO., the electrical contractors, of 1326 Chestnut street, are busy with a number of specialities, chief among which are the Eco-Magneto time detectors, etc., which they represent in Pennsylvania, Delaware, Maryland, Virginia, District of Columbia, New York State, west of Utica, and New Jersey, south of Trenton.

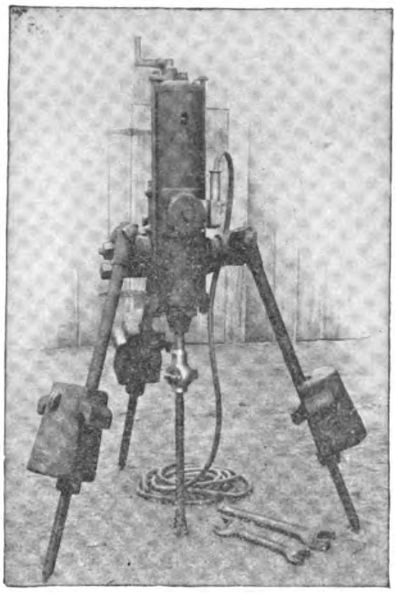
THE MESTON ALTERNATING FAN MOTORS are winning a good name for themselves in Philadelphia, where they are being extensively introduced. The selling agents here are Walter C. McIntire & Co., of 506 Commerce street, and Harry S. Smith & Co., Limited, of 607 Chestnut street.

THE ELECTRIC APPLIANCE CO., Chicago, are supplying their customers and the general trade with a complete catalogue of the Meston motor, showing its various adaptations for ventilating, dental, sewing machine and light power work. The Emerson Company are pioneers in this field of electrical work and as this is the first catalogue of the kind ever published, it makes very interesting reading and contains valuable information for central stations supplying alternating currents.

THE GENERAL ELECTRIC CO.'S ELECTRIC PERCUSSION DRILL.

The electric percussion drill since it was first put into practical operation, has undergone many changes, each tending towards perfection, until to-day it can compete successfully with either the steam or the compressed air drill. One of the most interesting percussion drill plants is that in operation at the limestone quarries of the Solvay Process Company, near Syracuse, N. Y. This plant has now been working continuously for several months and the excellent results obtained, both in amount of work done by the drills, and the convenience and economy of their operation and maintenance have given thorough satisfaction to the company first undertaking their general employment. Installed by the General Electric Company at the commencement of the past winter, the drills have operated without any interruption from the intense cold, and have practically demonstrated the advantages derivable from the use of electricity in quarry work. Had steam been the only available power, the loss in transmission by condensation at 20 degrees below zero would have been so great that the drills could not have been worked. The quarry is situated in a desolate spot on an elevated plateau, where the intensely cold winds find full scope for action.

At the present time three "Type E," General Electric Company's drills, are in continuous operation 10 hours per day, drilling holes from 6 to 10 feet in depth, and 2 to 2¼ inches in diameter at the top. The rate of drilling, according to the record kept by the superintendent, is from 45 to 75 feet per 10 hours, averaging 50 feet per day, or 1,500 feet per month of 30 days. The average distance of the drills from the power station is about 2,000 feet at the present time, the circuit, three lines of bare No. 0 copper wire, being extended to a distance of 3,000 to 3,500 feet from the power station in one direction.



THE GENERAL ELECTRIC CO.'S PERCUSSION DRILL.

The manipulation of the drill is in every respect as simple as that of the steam or air drill, stopping and starting being accomplished by merely throwing a handle to the right or to the left, making or breaking the contact between the cable and the terminals of the coils. Not the slightest difficulty is experienced in lubricating the wearing parts or in handling the drill.

The general dimensions of the "Type E" drills, three of which are doing all the deep hole drilling for the quarry, are:—Length over all, 49 inches; outside diameter, wrought iron tube, 7½ inches; length of stroke, 5 to 7 inches; blows per minute, 380.

The generator which supplies the power is of the bi-polar type, running at normal speed, and is provided with a device for directing the current alternately into the upper and lower coils of the drills. The difference of potential at the fixed brushes of the generator is 240 to 250 volts.

The generator is belted to a 9 x 12 inch Straight Line engine, supplied with steam at 90 pounds pressure from a horizontal tubular boiler, fuel for which is brought for three miles over the cable way in the buckets used to transport the lime rock from the quarry to the works. As yet no estimate of cost of repairs can be given because, up to date, there have not been any. Should, however, any part break down, it can instantly be replaced as all the parts are interchangeable.

The plant has aroused widespread interest among quarry operators in general, and has been visited and carefully inspected by many less prone to reject the good things which advanced science offers. That electricity is the ideal power for mine and quarry operation, only the most conservative now refuse to believe.

NEW ENGLAND NOTES.

THE RODNEY HUNT MACHINE COMPANY, Orange, Mass., manufacturers of the well-known turbine wheels, are meeting with marked success amongst users of water-power for electrical and other purposes, and amongst their most recent sales are the following:—

J. D. Kendall, Enosburg Falls, Vt., one 33-inch vertical wheel, mortise gears and shafting; American Mills, Rockville, Conn., one 12-inch left-hand wheel, horizontal shaft, cast iron case, all complete; American Twine Co., Canton, Mass., one pair of 18-inch right and left-hand wheels, horizontal, boiler iron flume, penstock and draft-tube, complete; D. L. & L. B. Goff, Pawtucket, R. I., one large No. 3 regulator; Glen Manufacturing Co., Berlin Falls, N. H., one 66-inch left-hand horizontal wheel, with boiler iron quarter turn, all complete; Fall Mountain Paper Co., Bellows Falls, Vt., two 36-inch special right and left-hand wheels, horizontal shaft, boiler-iron flume, pen-stock and draft-tube, all complete; J. Huxstable, Horning's Mills, Canada, one 12-inch left-hand, horizontal shaft and quarter-turn; Glen Manufacturing Co., Berlin Falls, N. H., one 36-inch right-hand, vertical wheel; Vermont Electric Co., Burlington, Vt., two 54-inch left-hand wheels, horizontal shaft, and two 27-inch left-hand wheels, horizontal shaft, with quarter-turns and large driving pulleys, all complete; Neshobe Electric Co., Brandon, Vt., one 18-inch left-hand wheel, horizontal shaft, cast iron case and quarter-turn; Bay View Electric Co., Bay View, Md., one 24-inch right-hand, vertical wheel, cast iron case, mortise gears, pen-stock, bridge-tree, draft-tube, etc., all complete; High Falls Sulphite Pulp & Mining Co., Canton, N. Y., one 12-inch right-hand wheel, horizontal shaft, cast iron case and quarter-turn, and one No. 2 regulator, all complete; The E. B. Eddy Co., Hull, Canada, one 39-inch right-hand vertical wheel, and one 30-inch right-hand, horizontal wheel, cast iron quarter-turn and large No. 2 regulator, all complete.

THE MASSACHUSETTS CHEMICAL COMPANY, of Boston, are announcing to their friends in the electrical business that they have perfected a new black paint, to which they have given the name of "Enamelac," specially adapted for car trucks, conduits, iron poles, batteries and machinery, and that they are now ready to supply the demand. Enamelac is said to contain no rubber to rot out, is proof against the action of acids and water, contains no poisonous and foul smelling gases, gives a hard glossy surface equal to japan, dries hard in one hour, is a great surface coverer, and is inexpensive. The material is the product of a secret process, and if it meets with half the success which Insullac has attained it is safe to say that they will soon be kept busy filling the demand.

THE ELEKTRON MANUFACTURING COMPANY, of Springfield, Mass., Mr. E. Marshall, has opened an office at 103 Milk street, Boston, for the purpose of introducing in Boston the Elektron Company's electric elevator, which has given great satisfaction in other cities. Mr. Marshall will be manager of the elevator department in Boston, and will have associated with him Mr. F. B. Corey as electrician. Mr. Marshall has been in the elevator business for a number of years and is well versed in all the requirements of such apparatus, and should make a valuable acquisition to the staff of the Elektron Company.

ELECTRIC HEAT ALARM COMPANY, Boston.—Mr. F. E. Palmer has recently returned from Chicago, where he has installed a handsome sample board showing their system of electric heat alarm for buildings, mills, shafting, etc. The company recently equipped one large factory at Haverhill, Mass., with their system, and have just received contracts from three other large mills, all of which desire to put in their system at the earliest moment.

A RECEPTION TO MR. JAMES I. AYER.

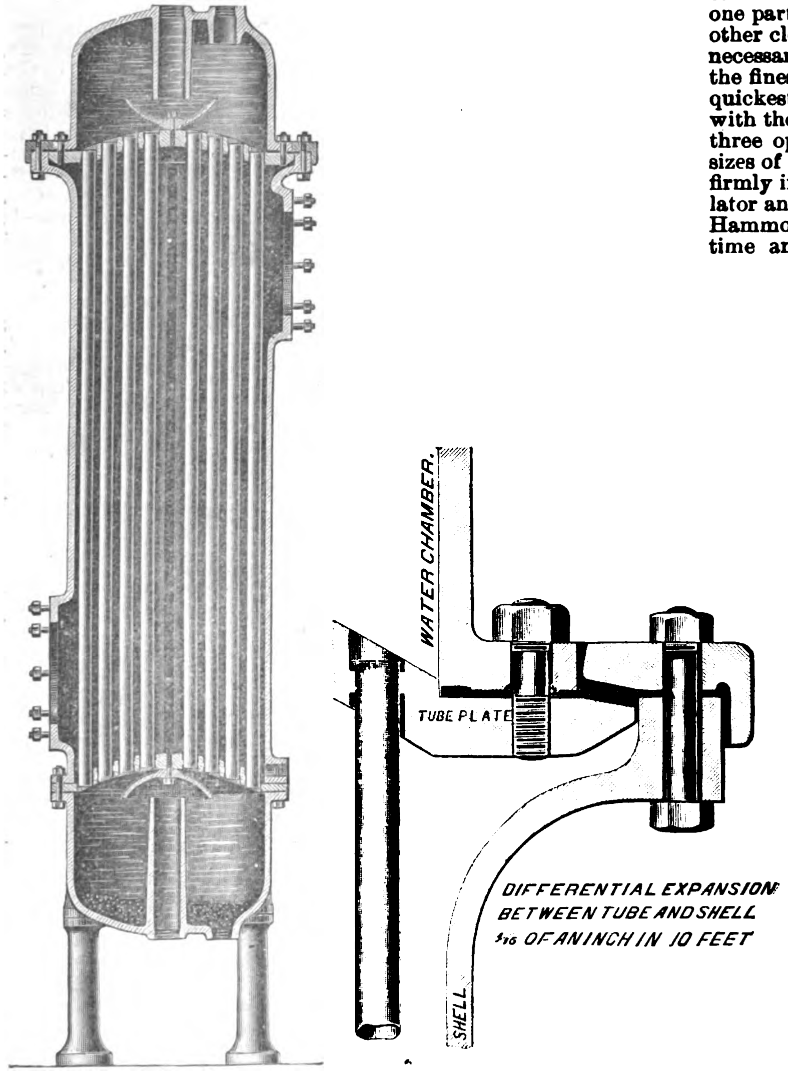
As a little recognition of the many courtesies extended to Eastern men in St. Louis at the time of the recent electric light convention, by Mr. James I. Ayer, then president, it is proposed to return the compliment and to entertain him in a modest way at a planked shad dinner at Gloucester, N. J., when he comes East in a few weeks. Messrs. J. A. Seely, C. O. Baker and C. A. Bragg are organizing the dinner.

MR. J. GRANT HIGH, of 123 North Third street, Philadelphia, has succeeded to the business of High & Miller, who have been dealers in second-hand electrical apparatus, etc. The new concern will carry on the old trade, and has established a fine factory for the manufacture of single and double pole switches, of the best construction and at moderate rates. It will also contract for all manner of machinery, dynamos, motors, etc.

THE IMPROVED GOUBERT FEED WATER HEATER.

The Goubert feed water heater shown in Fig. 1, has many points of superiority and not the least of these is the joint between the heater shell and the upper water chamber. It is what is known as an expansion joint and is the only joint in the heater that is not rigid. The differential expansion between the shell and the brass tubes is taken care of at this point. The joint is illustrated in detail in Fig. 2.

Its peculiarity of construction will be readily seen. The upper tube plate is firmly bolted to the upper water chamber and between these and the heater shell is the joint referred to, so constructed, that either the shell or the tubes may expand independently, an intervening copper gasket bending sufficiently to allow for the differential expansion. This free joint presents another advantage not always considered, though of great importance. Although free to move in response to expansion, the tube plate fits into the shell sufficiently close to prevent the racking and consequent loosening of the tubes in transporation. This is a great advantage over other feed water heaters with tubes rigid only at the lower tube plate.



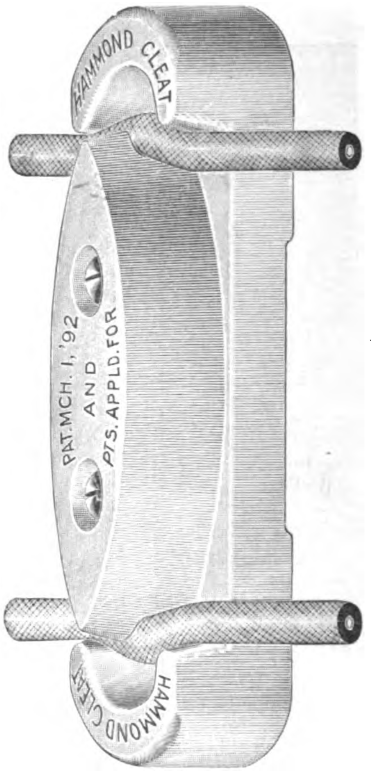
Figs. 1 and 2.—Improved Goubert Feed Water Heater.

This being a water-tube heater and the pressure being within the tubes, the shell and the joint referred to have only to stand the pressure of the exhaust steam. These points combined with the other peculiar advantages of the heater make it a superior apparatus in every respect for the purpose intended and account for its great and constantly growing popularity. The Goubert Manufacturing Company, 32 Cortlandt street, New York City, are the sole manufacturers and are represented by well-known business firms in all the principal manufacturing centres of the United States.

The Star Electric Lamp Company is the recipient of many letters of congratulations upon the splendid results accomplished in getting on the market so promptly a first-class commercial lamp. The lamp is an entirely new production. The lamps that have been delivered are proving highly satisfactory and orders are coming in rapidly. This must be gratifying to the company as they have been to great expense in pushing their experiments forward, and equally a pleasure to the company to know that the electrical fraternity appreciate their efforts as shown by the liberal reward they are receiving in the way of orders.

THE HAMMOND CLEAT.

We illustrate in the accompanying engraving the new Hammond cleat which has just been put on the market. The illustration explains the action of the cleat so that it is hardly necessary to describe it. It is simplicity itself. As will be seen, it is all in one part, being essentially different in this particular from any other cleat, and can thus be attached to the ceiling or wall when necessary, complete, before the wires are strung. It is made of the finest grade of porcelain, and being in one piece furnishes the quickest and easiest method of wiring. It does away entirely with the unsightly tie wire, and can be made with one, two or three openings, which are adapted to receive all the ordinary sizes of wire without injuring the insulation. It holds the wire firmly in position, and as the wire winds on the body of the insulator and not on the retaining points, all breaks are avoided. The Hammond cleat probably excels all other cleats in the saving of time and material, and the prices are exceedingly low. It is being made by the Hammond Cleat and Insulator Company, whose office is at 220 Devonshire street, Boston, and of which Mr. F. W. Brigham is the secretary.



The Hammond Cleat.

New "Interior Conduit" Catalogue.—A handsome specimen of artistic work is the new catalogue of the Interor Conduit and Insulation Company. In addition to a description of the many devices applicable to interior wiring the catalogue contains complete specifications for the installation of the Interior Conduit system and also a code for customers who may wish to order by telegraph or cable. The Johnson switch, the Lundell motor, and all devices are constructed to conform to standards and are particularly applicable to the Edison system of distribution.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XV. MAY 31, 1893. No. 265.

PROFESSOR MOSES GERRISH FARMER.

A FAVORITE phrase of the old-time New Englander, when seeking to attribute the most exalted degree of wisdom to some philosopher of local renown, was to say that "he had forgotten more than the rest of us ever knew." Yet few men have lived in our time of whom this might be affirmed, with less of humorous exaggeration, and more of literal truthfulness, than of that greatest of American electricians, Moses Gerrish Farmer, who, after a long, busy and eminently useful life, fell asleep on the 25th of May, 1893, at the venerable age of 73. Many years ago, another prominent electrician said of him: "Moses G. Farmer has undoubtedly done more real and lasting good to his fellow-man through his uncompleted and abandoned inventions, than through those which he has perfected; for the former are like thousands of seed-thoughts scattered over the world, which many will gather up, and from them reap bountiful harvests after his life-work is over." This prediction has already been abundantly fulfilled. More than one inventor might be mentioned to-day whose names have become a household word throughout the civilized world, who have reaped fame and fortune from the successful exploitation of the knowledge of Nature's secrets which has been freely imparted by this most kindly and unselfish of men during his long life. The keenest observer would have failed in the effort to discover a trace of the spirit of jealousy or self-seeking in Prof. Farmer. This abnegation of self has been one of the principal charms which has drawn all hearts to him through the many eventful years of his life, during which it has been his privilege to benefit the world through his rare and wonderful mental gifts, which have always been at the command of friend or foe. To the highest and lowest he was alike accessible, and the advice and information, so constantly asked on all subjects, was never withheld. His profession required deep research and profound thought, and he found unending gratification in the search for the hidden things of science, that he might utilize them for the good of the human race.

PROF. MOSES G. FARMER

(By permission from Scribner's Magazine).

Moses Gerrish Farmer, eldest child of Col. John and Sally (Gerrish) Farmer, was born in Boscawen, N. H., February 9, 1820. In early life he attended the district school and academy in that town; and entered Phillips academy at Andover, Mass., in the autumn of 1837.

He entered Dartmouth college in 1840, remaining three years, being ultimately compelled to discontinue his studies on account of ill health. The degree of A. M. was conferred upon him by the faculty of Dartmouth in 1853.

A few months after leaving college, he became Preceptor of an academy, in Eliot, Me., and was married in that town on December 25, 1844, to Hannah Jobey, daughter of Richard and Olive Shapleigh, of Berwick, Me. He removed immediately to Dover, N. H., being at the time in charge of the Belknap school in that town, where he taught until the summer of 1847, after which time he turned his attention wholly to scientific pursuits, which where much more congenial to his tastes than pedagogy.

Mr. Farmer's first experiments in electricity were made as early as 1845, at which date he invented an electromagnetic engine. In 1846 he constructed a miniature electromagnetic locomotive, with a suitable railroad track, and exhibited the outfit in various towns and cities, accompanying the exhibitions with a lecture upon the subject of electromagnetism and its applications, in the course of which he showed how it could be utilized in connection with torpedoes and submarine blasting. His very first lecture was given in Dover, N. H., and one of the experiments was made with a miniature ship which was placed in a wash-bowl of water. The ship was blown up by electricity, and, coming down, alighted with a "dull thud" on the top of the lecturer's head. This may possibly have been the reason why the experiment was never repeated before another audience; but the circumstance may profitably be recalled at the present day, when ships may so quickly be converted into kindling wood by the torpedoes which he has handled with such masterly skill, during his service under the United States Government.

In 1846 he invented the hook or sickle-shaped climber, for the use of repairers of telegraph lines in climbing poles, and, a tradition has been handed down, came near losing his life in showing how easy it was to use them.

About this time Mr. Farmer made the acquaintance of Hon. Francis O. J. Smith, who was then the most prominent autocrat in all telegraphic matters in the New England states, which finally resulted in Mr. Farmer taking up his residence in South Framingham, Mass., in December, 1847, where he opened a telegraph office in the depot, and also had charge of the old Morse line between Boston, Worcester and Springfield. While employed at this place he tried the experiment of telegraphing with a current from an induction coil, using a common medical machine for the purpose.

Early in the winter of 1848, Mr. Smith, then president of the Portland Morse line and L. L. Sadler, superintendent of the Boston and New York line, were one day discussing the possibilities of the telegraph, and the uses to which it might be applied; Mr. Smith suggested that an alarm of fire might be given by it, but asked, "Where is the man who can devise the machinery to do it?" Mr. Sadler replied—"I have an operator in my employ in Framingham who can do it if anybody can; he is the most ingenious man I ever saw. His name is Farmer." "I know him," said Smith; "yes, he can do it, if it can be done." Mr. Farmer's attention was at once called to the subject, and he asked for time in which to consider it. At the end of a week he showed them what he had done. He had taken the striking mechanism of an old clock, and invented the electrical part necessary to construct a miniature machine, which clearly demonstrated the conception in operative form. This was the first machine ever constructed in the world for giving an alarm of fire by electricity. Messrs. Smith and Sadler were well satisfied with the experiment, but were too much absorbed in their telegraph interests to do anything further at that time. Not so with Farmer. If this were something possible to be done, and something the world needed, the time must surely come when it would be carried into effect, and his active mind was constantly devising ways and means by which to accomplish it. All this reflection proved a great help to him when he was actually called to the work in Boston in 1851, as superintendent of the fire alarm system.

Strange as it may seem at the present day, the bitterest enemies of the new system, were the firemen; they lost no opportunity to decry it, or to prevent its success. At that time the fire department was a volunteer organization; fire companies were clubs, in some instances political cabals. False alarms were frequent, as it was very easy to start the cry of "Fire." The telegraphic system tended to prevent false alarms, and consequently much pleasurable excitement. With such a man as Farmer, however, there was no such word as fail; and the work went steadily forward. He did not lay down the burden of it until 1859, when he felt that it had become old enough to be wholly committed to the care of others. He generously gave to the city a license, waiving all his rights under the patent law. He resigned the active position of superintendent in August, 1855, but for the next four years the city had the benefit of his skill and experience upon which to rely in every emergency.

This was the fire alarm telegraph of the past. To-day it is in use in more than 100 cities and towns in the United States and Canada, and has saved thousands of lives, and millions of property. If this had been his life work, and the whole of it, it would have been worth living for; but it proved to be only the beginning.

In 1855 Farmer successfully deposited aluminum from its chloride solution, which never had been accomplished before. He also succeeded in depositing copper in a condition both hard and brittle—a great achievement in electro-metallurgy. In 1856 he produced the first undercut electrotype from a gutta percha mould. He also made a sheet of copper one-eight of an inch thick, brittle as glass; another wonder in electro-metallurgy. In this year he also devoted much attention to electric repeaters, electric clocks, and printing telegraphs. He constructed for the Dudley observatory, at Albany, N. Y., a chronograph and system of electric clocks. He invented, in conjunction with Asa F. Woodman, the first closed-circuit automatic repeater for telegraph lines. In 1856 he constructed and sold a large number of gyroscopes, to one of which he applied an electromagnetic motor, by which he kept it in continual and rapid rotation.

As early as 1852, Farmer's attention was directed to the subject of multiplex telegraphy. Before 1855, he had devised and constructed an apparatus by which he was able to transmit four messages simultaneously over a single wire. This was 12 years before Mr. Stearns brought out his earliest apparatus known as the "Stearns duplex." About this time Farmer devised a most ingenious printing telegraph, which was the first to make use of what is known as the "automatic unison stop" and the "sunflower transmitter." He was undoubtedly the first to suggest the use of the continuity preserving-key in the duplex telegraph and was the originator of the "polar-duplex" which makes use of independent current reversals in transmission. He perfected double transmitters with reversed current and constant resistance, which constitutes the most essential feature of the modern quadruplex telegraph and successfully worked a telegraph duplex line between Boston and Worcester, in 1856, both instruments being in the Boston office, two messages being sent simultaneously in opposite directions.

In 1852–3, permission was granted to Captain Charles Wilkes, U. S. Navy, to use the circuits of the fire-alarm system, to determine the velocity of sound. Mr. Farmer constructed a special chronograph for this purpose, and many experiments were made, the results of which were duly published by Captain Wilkes.

During the winter of 1855–6 he continued his experiments in duplex and printing telegraphs. In 1857–8 he prosecuted a long series of experiments with double transmitters and constructed a duplex printing telegraph, driven by an electromagnetic motor. In 1858 he devised electromagnetic apparatus to show the height of water in steam boilers, tanks, reservoirs, etc. During the year 1858 he began a series of investigations upon the production of light by electricity, and invented an automatic regulator, by which a large number of incandescent lamps in multiple arc can be kept at a uniform voltage for any length of time. During the month of July, 1859, he had one of the rooms of his dwelling-house in Salem, Mass., lighted every evening by incandescent electric lamps, using filaments of platinum and of iridium. The light was very beautiful, and attracted a great deal of attention from the many visitors who came to see it. The cost of producing the light from voltaic batteries was found to be so great that it was unprofitable, at that time, to pursue the subject.

In 1867 Mr. Farmer discovered the principle of the modern self-exciting dynamo, which he described in a letter to Wilde, and in which he was in advance in point of time, of either Wheatstone or Siemens.

Early in the year 1871, his attention was again turned to the practical improvement of the dynamo-electric machine and during that and the following years he manufactured a large number of these for depositing copper and other purposes. He has made many valuable improvements in the construction of these machines, especially in the one designated. His wise counsels and extensive knowledge of electrical science proved to be of inestimable value to the Government. A class of 20 naval officers was immediately put under his instruction, and from that time forward it was ever his highest ambition to discover and develop to the utmost the inventive talent and genius of his pupils. Unlike too many instructors, his pride lay rather in showing what his students were themselves able to accomplish, than in parading the extent and importance of his own knowledge. In 1882, the condition of his health compelled Prof. Farmer to relinquish his duties at the Torpedo Station, and with his wife and daughter, and a faithful attendant, he retired to the charming country residence which he had prepared for himself, the childhood home of his beloved companion, in Eliot, Maine, a retreat which cannot be better described than by the quaint name which was given it by the family, "Bitter-sweet-in-the-fields."

Here, in this peaceful haven of rest, Prof. Farmer's later years were passed. The busy brain was never more intensely active, but the willing feet were never again to go upon their errands of love, mercy and duty. A paralytic affection confined him to his wheel-chair, and baffled the efforts of the highest medical skill for its relief.

At length came the great Columbian Exposition of 1893. Prof. Farmer could not resist the desire to visit Chicago, that he might behold the fruition of the art and science to which he had devoted his life. So in October last, disregarding—and who shall say unwisely—the advice of physicians and friends, he took up his abode where he could view the daily increasing glories of the great White City. One cannot but feel a sensation of gratitude that he was at least permitted to view the promised land—to behold the potency and promise of all that is yet to be; the wondrous victories of the battle field he has made his own. And here the end came; a sudden attack of pneumonia which his enfeebled constitution was unable to withstand, and after a few days' illness, he passed away.

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Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 208 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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VOL. XV. NEW YORK, MAY 31, 1893. NO. 265.

MR. TESLA'S LATEST WORK.

IT will be remembered that, a couple of months ago, Mr. Tesla delivered before the Franklin Institute in Philadelphia and the National Electric Light Association at St. Louis, a lecture embodying some of the latest results obtained by him in investigating the effects of high frequency, high potential currents. We gave at the time a careful synopsis of the leading points of the lecture, and are glad now to print it in extenso, supplemented by a number of excellent illustrations, for which our thanks are due Secretary Porter of the N. E. L. A.

Viewing Mr. Tesla's lecture as a whole, one is struck by the variety of methods employed and the mass of novel facts and ideas presented. To enumerate them all would be practically repeating the lecture itself and in this necessarily short comment we must restrict ourselves to the most salient features.

To the superficial reader, Mr. Tesla's introductory remarks may appear as a digression, but the thoughtful reader will find therein much food for meditation and speculation. Throughout his discourse we can trace Mr. Tesla's effort to present in a popular way thoughts and views on the electrical phenomena which have in recent years captivated the scientific world, but of which the general public has as yet merely received an inkling. Mr. Tesla also dwells rather extensively on his well-known method of high-frequency conversion; and the large amount of detail information will be gratefully received by students and experimenters in this virgin field. The employment of apt analogies in explaining the fundamental principles involved makes it easy for all to gain a clear idea of their nature. Again, the ease with which, thanks to Mr. Tesla's efforts, these high-frequency currents may now be obtained from circuits carrying almost any kind of current, cannot fail to result in an extensive broadening of this field of research, which offers so many possibilities. Mr. Tesla, true philosopher as he is, does not hesitate to point out defects in some of his methods, and indicates the lines which to him seem the most promising. It is manifest, judging from the tenor of his remarks, that the production of an economical practical illuminant is now merely awaiting the perfection of this, or analogous methods. Particular stress is laid by Mr. Tesla upon the employment of a medium in which the discharge electrodes should be immersed in order that this method of conversion may be brought to the highest perfection. He has evidently taken pains to give as much useful information as possible to those who wish to follow in his path, as he shows in detail the circuit arrangements to be adopted in all ordinary cases met with in practice, and although these methods were described by him two years ago, this additional information will be timely and welcome.

Coming now to the experiments he dwells first on some phenomena produced by electrostatic force, which he considers in the light of modern theories to be the most important force in nature for us to investigate. At the very outset he shows a strikingly novel experiment illustrating the effect of a rapidly varying electrostatic force in a gaseous medium, by touching with one hand one of the terminals of a 200,000 volt transformer and bringing the other hand to the opposite terminal. The powerful streamers which issued from his hand and astonished his audiences formed a capital illustration of some of the views advanced, and afforded Mr. Tesla an opportunity of pointing out the true reasons why, with these currents, such an amount of energy can be passed through the body with impunity. He then showed by experiment the difference between a steady and a rapidly varying force upon the dielectric. This difference is most strikingly illustrated in the experiment in which a bulb attached to the end of a wire in connection with one of the terminals of the transformer is ruptured, although all extraneous bodies are remote from the bulb. He next illustrates how mechanical motions are produced by a varying electrostatic force acting through a gaseous medium. The importance of the action of the air is particularly illustrated by an interesting experiment.

Taking up another class of phenomena, namely, those of dynamic electricity, Mr. Tesla produces in a number of experiments a variety of effects by the employment of only a single wire with the evident intent of impressing upon his audience the idea that electric vibration or current can be transmitted with ease, without any return circuit ; also how currents so transmitted can be converted and used for many practical purposes. A number of experiments are then shown, illustrating the effects of frequency, self-induction and capacity ; then a number of ways of operating motive and other devices by the use of a single lead. A number of novel impedance phenomena are also shown which cannot fail to arouse interest.

Mr. Tesla next dwells upon a subject which he thinks of great importance, that is, electrical resonance, which he explains in a popular way. He here expresses his firm conviction that by observing proper conditions, intelligence, and possibly even power, can be transmitted through the medium or through the earth; and he considers this problem worthy of serious and immediate consideration. The views expressed by Mr. Tesla will certainly interest all who have followed his work.

Coming now to the light phenomena in particular he illustrates the four distinct kinds of these phenomena in an original way which to many must have been a revelation. Mr. Tesla attributes these light effects to molecular or atomic impacts produced by a varying electrostatic stress in a gaseous medium. He illustrates in a series of novel experiments the effect of the gas surrounding the conductor and shows beyond a doubt that with high frequency and high-potential currents, the surrounding gas is of paramount importance in the heating of the conductor. He attributes the heating partially to a conduction current and partially to bombardment, and demonstrates that in many cases the heating may be practically due to the bombardment alone. He points out also that the skin effect is largely modified by the presence of the gas or of an atomic medium in general. He shows also some interesting experiments in which the effect of convection is illustrated. Probably one of the most curious experiments in this connection is that in which a thin platinum wire stretched along the axis of an exhausted tube is brought to incandescence at certain points corresponding to the position of the striæ, while at others it remains dark. This experiment throws an interesting light upon the nature of the striæ and may lead to important revelations.

Mr. Tesla also demonstrates the dissipation of energy through an atomic medium and dwells upon the behavior of vacuous space in conveying heat, and in this connection shows the curious behavior of an electrode stream, from which he concludes that the molecules of a gas probably cannot be acted upon directly at measurable distances.

Mr. Tesla summarizes the chief results arrived at in pursuing his investigations in a manner which will serve as a valuable guide to all who may engage in this work. Perhaps most interest will centre on his general statements regarding the phenomena of phosphorescence, the most important fact revealed in this direction being that when exciting a phosphorescent bulb a certain definite potential gives the most economical result. A great many more observations of Mr. Tesla relating to this subject, of such great interest, might be mentioned, but the careful reader will find in nearly every paragraph a thought or suggestion. The lecture is not one for hasty reading.

LARGE ELECTRIC RAILWAY NETWORKS.

All careful observers of electric railway work have been impressed with the rapid manner in which the electric railway industry is overleaping the bounds of street railways and occupying the field of suburban and rural travel. It is true that many large schemes of city work have still to be carried out, involving millions of dollars, and that every week brings news of a dozen new roads in minor towns; but the pioneer work is now being done in sections of country that never before knew anything better than dusty pikes and muddy lanes. The ease with which the electric roads cut their way into regions of plow and pasture and stretch their wires between points fifty miles apart, is arousing great interest in steam railway circles, and provoking a sentiment in which hostility and consternation mingle. The attitude of opposition assumed, for example, in Connecticut by the Consolidated Road, is absurd. Any steam road affected by electric competition will find it better to adopt and favor the newcomer than to fight and restrict it.

We publish various items this week indicative of the trend of events, but none more significant than the article on the project of the Put-in-Bay & Southwestern Company, which proposes to make one of the choice parts of Ohio its own, develop new traffic in a fine area, and bring together a number of prosperous and progressive communities, some of which are forty or fifty miles apart. The road connects half a dozen populous county seats, taps and feeds fourteen steam roads, traverses a rich farming country, and, as our article points out, can depend for income on no fewer than three distinct classes of passenger traffic. With this road, intercommunication will become swift, cheap and incessant all along the line. The shuttles will fly to and fro every minute of the day, and the earning capacity of the system will be at a maximum all the time. What will become of the old wagon roads we do not know, but we do know that every farmer will head his produce toward these electric tracks.

The electrical details of the road are simple and feasible, but a curious part of the plan is that the road is to operate under the steam railroad laws of the State. There will be 106 miles of through line and every electric street railway system will be tributary.

The Chicago Electrical Congress.

We furnish in this issue the preliminary programme of the Chicago Electrical Congress. It is an excellent piece of work, and promises well for results. At the same time, it seems to us that the Programme Committee might have chosen its provisional chairmen a little more carefully. Prof. A. Graham Bell is given one of the most important divisions, although as a matter of fact he has taken no active interest in electrical matters for years past. When president of the American Institute of Electrical Engineers a few years ago, he did not take the trouble to attend a single meeting, and made neither an inaugural address nor any other kind of acknowledgment of the honor done him. He is out of touch with modern electrical advance, and the highly useful work he is doing is in no sense whatever electrical. The chairmanship of Section C should go to a man like Prof. Anthony or Prof. Carhart, either of whom is fully abreast of all that is going on in the departments included.

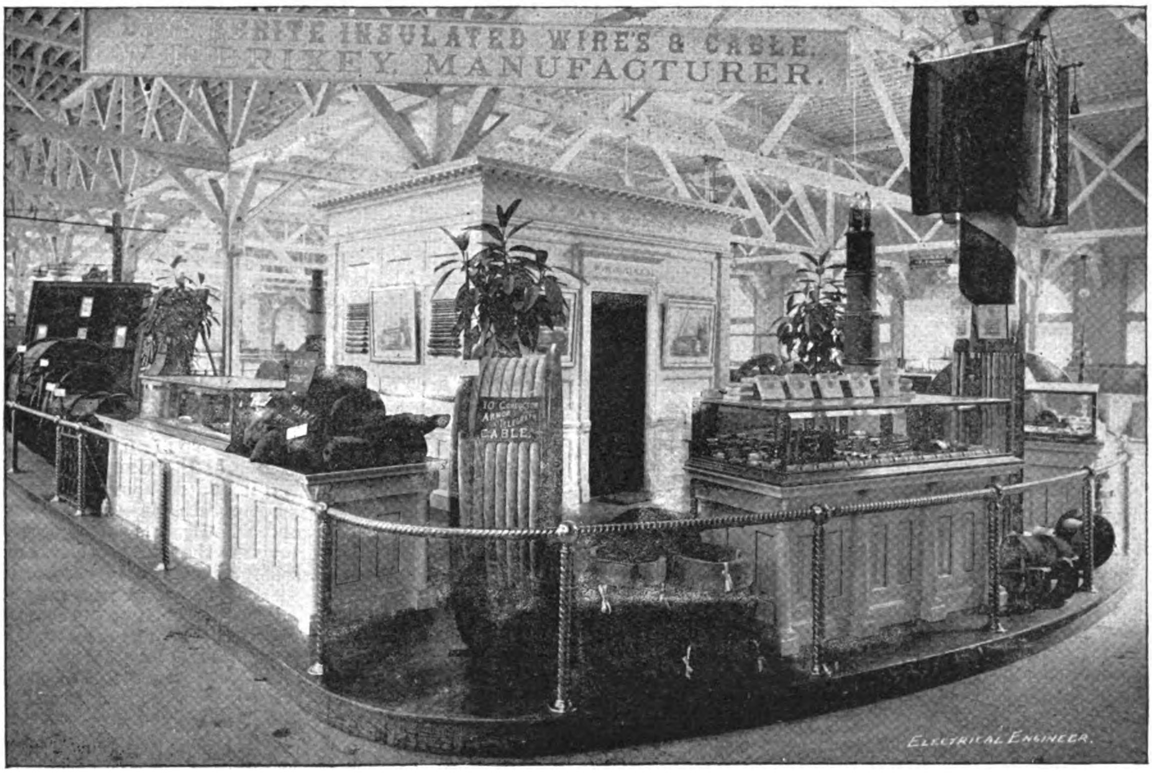
THE ELECTROCHEMICAL ACTINOMETER.

In a recent number of the *Comptes Rendus*, M. Rigollot gives a further account of his experiments on the electrochemical actinometer. He finds that the E. M. F. developed when light falls on a plate of oxydized copper immersed in a solution of a metallic iodide, bromide or chloride can be considerably increased if it has previously been dipped in some coloring matter, such as eosine or safranine. This increase of sensitiveness is different for rays of different wave lengths, and those rays which produce the maximum effect, for any one coloring substance, depend on the position of the absorption band in the light which is transmitted by that substance.

WORLD'S FAIR DEPARTMENT.

KERITE AT THE FAIR.

ONE of the most artistically arranged displays yet completed in the Electricity Building is that of Mr. W. R. Brixey, manufacturer of Day's Kerite wires and cables. The exhibit occupies section T, space 2, on the second floor, and stands directly at the head of the stairs, opposite the office of the chief of the Department. The accompanying illustration from a photograph gives an excellent idea of the general appearance of the space. The pavilion is painted white with gold trimmings and is finished within in polished sycamore, and with its handsome furniture, "lockers," etc., looks much like the captain's cabin on an ocean liner. Mr. Brixey is a "smart old salt."



THE "KERITE" EXHIBIT AT THE WORLD'S FAIR.

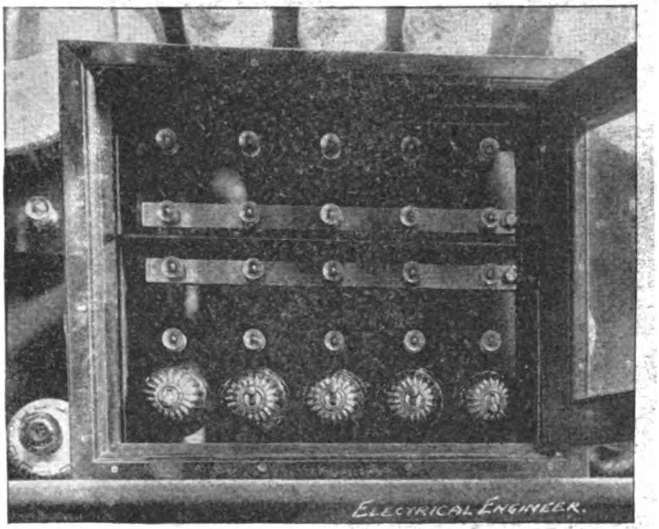
The exhibit proper has been very carefully selected with a view to showing all the steps in the manufacture and application of this standard insulation, from the tree to the armored submarine cable. In order to give Nature proper credit for her share in the work, the first stage in the evolution of Kerite from sap is shown by four complete rubber "plants" in actual operation, so to speak, whose polished, dark-green leaves look delightfully cool and shady among the varicolored reels of wire and set off by the pure white of the pavilion. Near by are piles of pure Para rubber just as received from South America, purified rubber after being stripped and washed ready to be ground, crude Kerite compound which is used with the rubber to give it life, and finally rubber and crude Kerite mixed, forming the Kerite proper, ready to be moulded upon the wire. The successive steps in wire and cable manufacture are then shown. Here are wires covered with "plain insulation," *i. e.*, bare Kerite simply vulcanized. Other samples show a braid over this, and still others show the braid painted with a waterproof or a fireproof compound, as the uses to which the wire is to be put may require, and polished. The colors of these paints are made to match or harmonize with the woodwork or hangings of the rooms where the wires are run. At three of the four corners, just behind the handsome brass railing completely enclosing the space, stand immense reels of armored submarine cable. This is shown with from one to ten conductors for telegraphic use, and with 50 conductors for telephone service. At the fourth corner is a reel of 154-conductor underground telegraph cable, on top of which rests a smaller reel of eight-conductor aerial cable, 300 miles of which was recently put up for the new block signal system of the New York Central and Hudson River Railroad between Albany and Buffalo. Interspersed about the space are other reels of underground cable having from four to 91 conductors, while in the five glass cases extending around the front and sides are small sectional samples of ærial, submarine and underground cable, also stranded wire for electric light and power circuits, and twisted pair telephone wires for metallic circuit. In the cases are also shown the justly celebrated Kerite cloth tape, the Kerite elastic tape and the Kerite rubber tape.

Five graceful columns made of reels of gradually decreasing sizes upon which are wound wires of brilliant colors tower conspicuously above the other exhibits and aid in attracting the eye to the more strictly practical part of the display, while the excellence of Kerite, still claimed, after more than a quarter of a century, to be the standard of insulation, is vouched for by two diplomas of honor, hanging framed on the outer wall of the pavilion. One of these was awarded at Philadelphia in 1876 and the other at Paris in 1878. The medals given with them are displayed in one of the cases. The walls are still further embellished with pictures of the tug-boat "Western Union" laying an 18-conductor Kerite cable across the Hudson at New York, and by portraits of Mr. A. G. Day, the inventor of the insulation.

Mr. Avery P. Eckert, who is in charge of the exhibit for Mr. Brixey, has made his little "cabin" a charming resting-place for the weary and has started an electrical register of visitors. I venture to say that the Kerite space will be popular for the next six months.

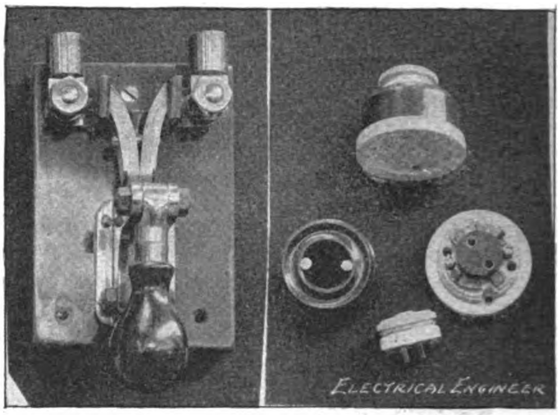
THE EXHIBIT OF THE GENERAL ELECTRIC COMPANY OF LONDON.

A LITTLE to one side of the centre of the Electrical Building, near the tower of light, stands a handsome black and gold booth containing the exhibit of the General Electric Company of London, arranged by Mr. Hirst, one of the members of the firm. This exhibit is particularly interesting as showing the modus operandi obtaining on the other side of the water in contradistinction to that which American practice permits. The damp climate of England as well as the conservative English character, have necessitated the use of a style of fittings not only intended for service at the moment, but for more permanent use than has been insisted upon in most cases in America. In the first place the electrical business of England is not in the hands, or under the control, of two or three companies, but is very widely distributed over the country and each manufacturer confines himself more especially to some one particular line of work in which he strives to excel; each, in fact, being a specialist in his own line. Again, when a large contract is to be given out in England it is customary to put it in the hands of a competent consulting engineer, who is so well paid for his trouble that it is usually to his interest to devote his whole time to the subject in hand, and see that it is accomplished in the most perfect manner possible. The fire insurance companies also have acted in a more scientific manner in regard to the causes of electrical fires than they have yet succeeded in doing here, and besides have co-operated to bring out a set of rules and regulations which the law requires to be stringently considered by contractors and which, though for a time exceedingly irksome, have in the end produced the result of compelling every manufacturer for his own good to devote more care to the construction of apparatus, to make a liberal calculation of carrying capacity of conductors, and to use the very best insulating material procurable, especially china.



DISTRIBUTION BOARD OF THE LONDON GENERAL ELECTRIC CO., LTD.

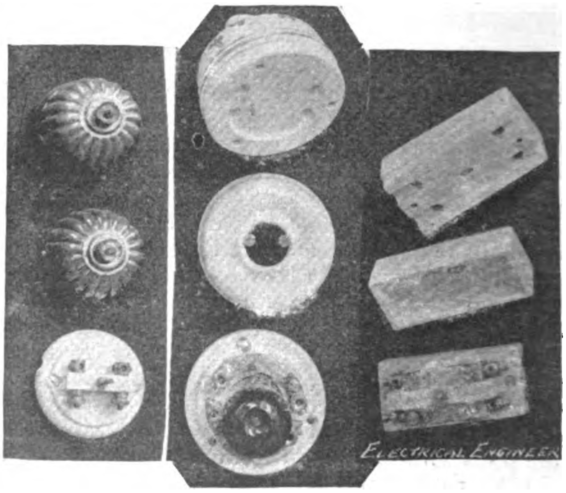
Perhaps no better proof of the success of this policy can be shown than the fact that no electrical fire has taken place in England in the case of any installation completed since the year 1886. After all, the defects in electrical work leading to such disasters are simple and can be placed under one of a very few heads, viz.: Overheating of wires caused by compelling a small conductor to carry a current greater than that for which it was intended; imperfect insulation of wires; leakage at the back of the fittings; arcing and inefficient insulating material, such as badly treated slate or fibre. In the very complete exhibit made by this company all these defects are claimed to have been obviated, and the apparatus shown exhibit in a high degree care in workmanship and excellence of design.



SUB-SWITCH, AND COMBINED WALL SOCKET PLUG AND SWITCH.

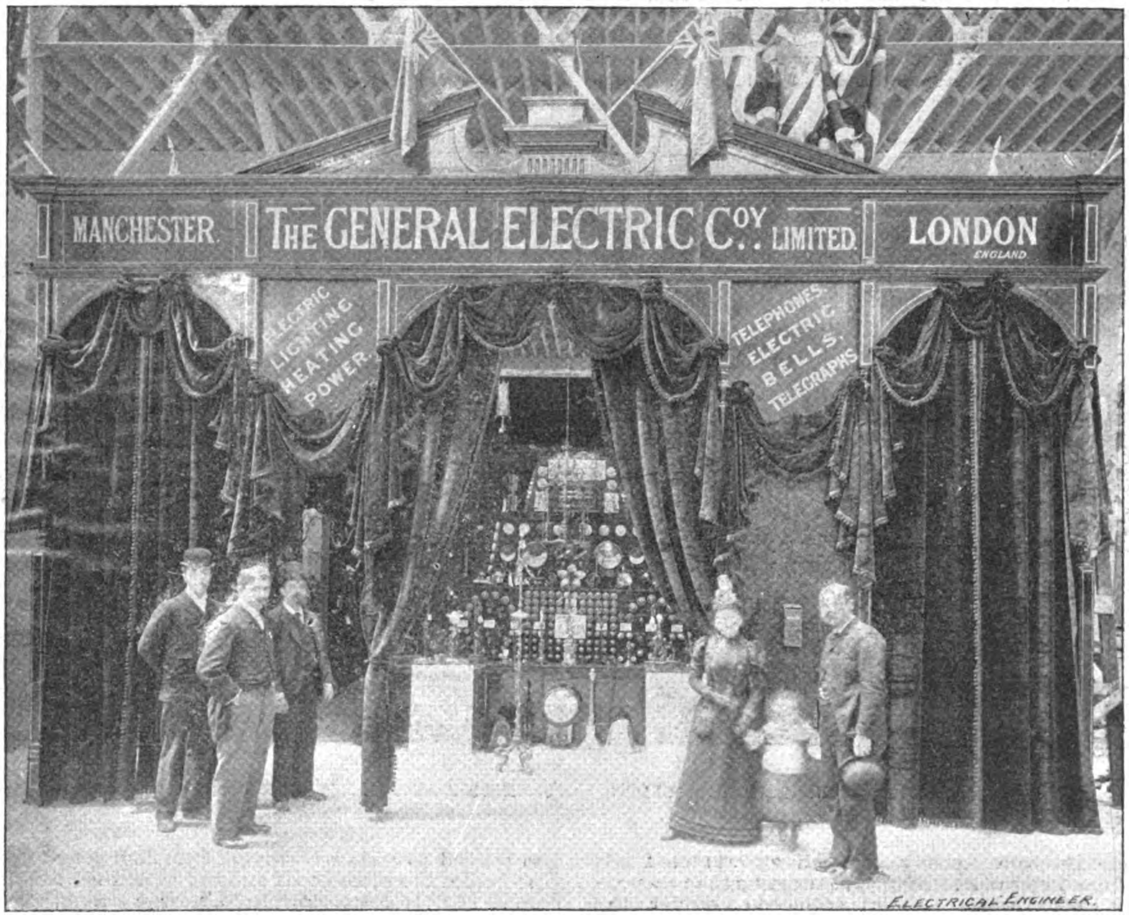
Wire.—It is the practice of the company to use no wires showing an insulation test of less than 300 megohms per mile in dry places and 600 megohms per mile in moist places. The carrying capacity is calculated at 500 amperes per square inch. In England the use of large cables in buildings is dying out and instead of bringing a 500 ampere cable from the source of supply it is customary to carry the leads from the dynamo to a distributing board from which radiate ten or more smaller independent circuits. These boards as will be seen, exhibit the most careful attention to points that are sometimes overlooked in this country. The metal parts are mounted on a piece of either porcelain or enameled slate, previously boiled in paraffin. Two main bars, one connected with each pole, form the terminals of the dynamo leads which enter the teak case through well insulated holes in the side. The two poles of the board are on separate slabs divided by an air space, and also by an insulating bar. By this arrangement, where slate is employed, any metallic vein that may occur, and that so often utterly unfits this material for electrical work, can have no injurious effect. Along the side of the bars run the sub-switches to which they are connected by fusible cut-outs.

Main Switches and Fittings.—A large variety of main switches form an important part of this exhibit. These instruments, besides being of very high finish and careful design are all provided with a link movement which gives them a double locking action. The contacts are all adjustable and the switches have large rubbing surfaces and proportionately long breaks. Perhaps the chief part of this exhibit, although not the most striking at first sight, is the great variety of small fittings, such as bronze switches, ceiling rosettes, cut-outs, lamp holders, wall sockets, etc. These are what are known as the "H. I." (high insulation) system of electric



CUT-OUTS AND SWITCH, LONDON GENERAL ELECTRIC CO., LTD.

fittings manufactured by this company. All of these instruments besides being insulated most carefully are thoroughly proof against fire, short circuit, or leakage of current from the conducting metal part to earth. The conductors are either screwed into the china itself or fitted to surface walls. There are no conducting parts at the back whatever, so that any dampness of the walls against which they are placed can have no possible effect upon them; fixing screws, covers, handles, etc., cannot come into contact with any metal parts carrying the circuits and all flexible cords are divided at the base by separating, insulating walls. Particularly noticeable in this large display are the Byng and link switches, which are shown in all sizes and with various degrees of ornamentation. To the manufacture of these switches the English porcelain lends itself particularly well. Not only will it take the coarse screw thread by which the cover is attached to the base, but the company have succeeded in tapping the base itself in such a manner that all the conducting metal parts can be screwed on from the front, thus leaving the back a perfectly smooth, insulating surface. The screws used to attach these little metal parts are in some cases not more than $\frac{1}{16}$ of an inch in diameter, and the porcelain threads are as clean cut and as firm as those in the metal. The process, however, is at present a secret. This method of attaching the working parts to the insulating material seems to be infinitely superior to that of covering the metal washers at the backs of the switches with shellac, plaster of Paris, and other substances of a like character, which are at best only makeshifts.



World's Fair Exhibit of the London General Electric Co., Ltd.

The ceiling rosettes, wall plugs, etc., and all such fittings as use flexible cords, have not only protection against moisture, but also a two-fold protection against inside arcing. A china wall inside, made in one piece with the base, supports the terminals of the leading-in wires and in addition to this supports the weight of the lamp or other fixtures attached, so that no strain of any kind is exerted upon the binding posts. This is accomplished by simply passing the leading-in wires through holes in the insulating wall and twisting them before taking them to the posts.

The cut-outs shown in this exhibit are of the latest pattern made by the company. The so-called "A" terminal for all currents up to twenty-five amperes, consists of a brass tube, the whole of which is in a straight line with the leading-in wire holes in the china base, and has a set-screw at the side so that the wire may be firmly clamped in the terminals.

General Notes.—Besides the various articles enumerated and illustrated here, the company show almost everything electrical needed for inside work. Particularly noticeable among these are electric fixtures in wrought iron, copper and brass, of which there are many interesting specimens. One complete set represents the solar system and consists of a large centre piece representing the sun, below which hangs a hammered iron circle with the signs of the zodiac depending from it in medallions set in hammered iron frames. The eight planets are placed about the room on ornamental and highly artistic iron brackets, each surmounted by an appropriate allegorical figure. This set occupies a conspicuous place in the booth and forms a striking and beautiful feature of the exhibit.

A new system of Binswanger electric cooking apparatus, patented in both the United States and England is also shown. This includes coffee-pots, boilers, chafing dishes, and, in fact, almost everything of use in the kitchen of a well-appointed house. A large and complete collection of telephones, electric bells, etc., is shown as designed by order of the English Government for Post Office use and for the telephone companies. An interesting piece of apparatus of which this company are also the original patentees and manufacturers is the Clarke electric gas lighter. This is a little instrument consisting of a tube about eighteen inches in length, with a handle one and a half inches in diameter and about five inches long, containing a little Wimshurst frictional machine actuated by pressing in a button at the end of a short transverse shaft extending into the handle so as to be readily actuated by the thumb when the instrument is held in the hand. The terminals of the machine extend through the tube and the break at which the spark occurs takes place at the extreme end. The instrument is thus always ready for use and needs no renewing.

A number of well-made ammeters and voltmeters on slate bases designed for from 50 to 1,500 amperes capacity are shown, as is also a Pentz-Reckenzaun meter. These instruments will form the subjects of later articles as they contain points which would perhaps be out of place in a general description of the exhibit.

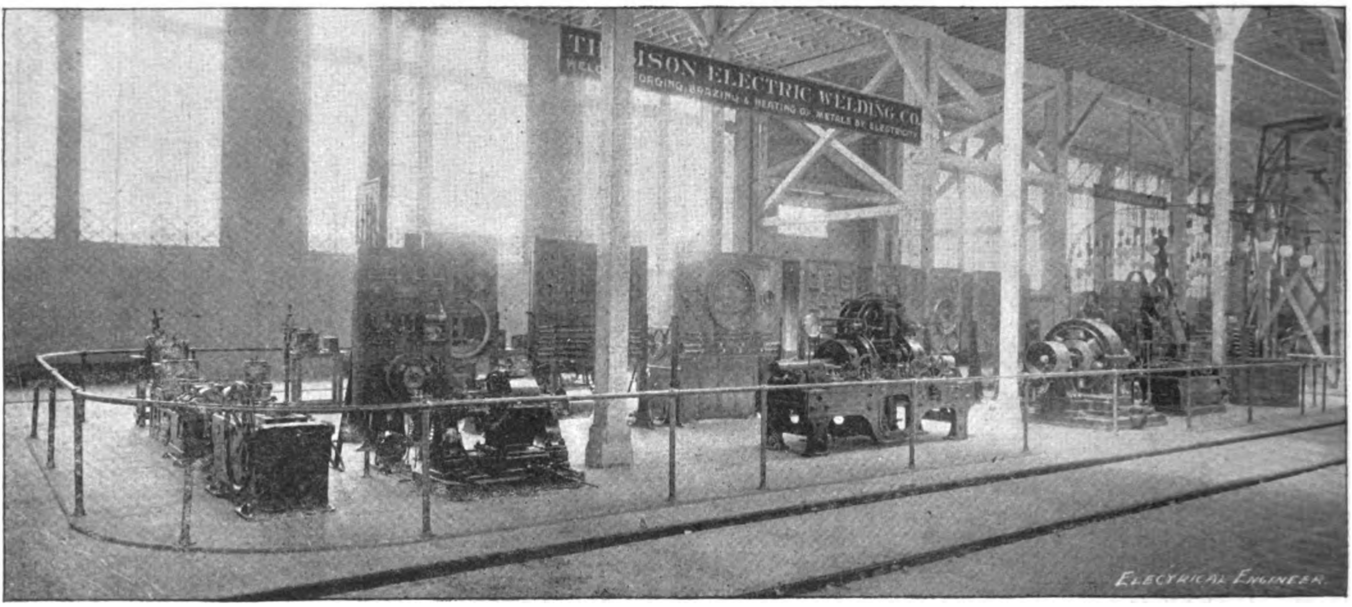
The whole display by this company is exceedingly creditable, and is more than usually interesting for purposes of comparison. Besides this, it is tastefully arranged and artistically designed, and, strange to say, is now complete; Mr. Hirst and his assistants having exerted themselves to that end with an energy that might with advantage be imitated by other exhibitors.

THE EXHIBIT OF THE THOMSON WELDING COMPANY.

The Thomson Welding Company, of Boston, are making a large exhibit in the Electricity Building. None of their apparatus is shown in actual operation, but the machines are connected up as though ready for service and the whole process of metal working by electricity can be followed from first to last. Eleven pieces of apparatus, including two complete plants and various miscellaneous mechanism, form the most striking and the largest part of the display. The larger of the two plants has a 60,000 watt alternator of 300 volts, separately excited, connected with a switchboard to which any number of welding machines, up to the full capacity of the generator, may be attached.

To this is connected a 40,000 watt universal welder designed to cover a large variety of work. The bed of this machine is built like that of a planing table so that clamps may be attached anywhere and odd shapes and sizes of metal readily fixed in position. It has a capacity of from one to three square inches of section and will take straight or curved pieces.

The generator of the other plant is one of 15,000 watts, of 300 volts potential like the other, but self-excited, and is connected with a 20,000 watt universal welder. A strapping device intended to show how different, irregular pieces of work may be attached is one feature of this machine, though for commercial use special forms of clamps are made. As a contrast to this is shown a special machine of the same capacity for welding tires up to 2 x ½ inch, and having a hydraulic attachment for giving the necessary upset when the weld is made. To this is attached a peculiar form of break switch operated by foot power for shutting off the current at the proper moment.


TH
ISON ELECTRIC WELDING CO.
ORGING, BRAZING & HEATING OF METALS BY ELECTRICITY
ELECTRICAL ENGINEER.

The Thomson Electric Welding Co.'s Exhibit at the World's Fair.

The largest welder forming part of the exhibit is one of 80,000 watts for pipe work. This will take pipes from three to six inches in diameter and is operated by hydraulic pressure throughout. Besides this it is provided with an automatic centering attachment and has four transformers in multiple, two above and two below, to insure a perfect distribution of the current.

Another interesting machine is one for upsetting the spokes of iron wheels. This was made for Messrs. Miles & Scott, of La Porte, Ind., and has been taken from actual service in their factory as an illustration of automatic electric forging.

A complete plant for copper and iron wire welding consists of a 1,000 watt self-exciting generator with a welder designed to handle work from one-fourth inch to No. 16 iron or steel wire. The clamps are separated by a lever having a catch to hold it in the proper position for the particular diameter of wire to be welded. The wire is then gripped and the lever released, allowing a spring to press the two ends of the wire together while the weld is being made, until the right point is reached, when a contact is automatically made that opens the break switch and throws off the current. A similar machine for copper wire from No. 6 to No. 16 is also shown, and near by is a combined heater and hammer for reducing the burr on iron and steel wire. The piece is clamped in jaws like those of a welder, the current is turned on and the wire brought to and maintained at a forging heat, while hammers operated by a flexible shaft deliver rapid blows on the enlarged portion and reduce it to its normal size.

There is also shown a set of arc welding apparatus where one terminal of the machine is connected to the work and the other to a carbon at the end of an insulated handle, and the arc formed between the two.

On the principle that the excellence of a process is best shown by specimens of finished work, the company devote considerable space to boards covered with samples loaned by various manufacturers of work done in their several factories. A brief reference to these will be interesting as showing the wide range of mechanical operations to which electrical welding is applicable. From the F. Wesel Manufacturing Co., of New York, are printers' chases with right angle welds at the corners, accurate to .002 inch; there are specimens of copper wire welding from the Benedict & Burnham Manufacturing Co., of Waterbury, Conn., and the Tamarack Osceola Copper Manufacturing Co., of Dollar Bay, Mich., the latter company showing a three-eighth inch copper bar with eight welds, and what was an exactly similar bar reduced to No. 14 wire, welds and all. The Parry Manufacturing Co., of Indianapolis, contribute a number of tires and hub bands, and from the Gendron Iron Wheel Co,, of Toledo, are shown all forms of tires, channel, crescent, oval, half oval and flat for bicyles, baby carriages, etc. The Electric Pipe Bending Co., of Harrison, N. J., show all sorts of pipe work for ice making and refrigerating machines; return bends with the weld in the centre, and also welded to steel or wrought iron flanges and female joints; pipe welded to square bends and to forged steel couplings, and a number of specimens showing the great strength of the welds under severe tests. These pieces have been bent and twisted out of all semblance to their original forms, and subjected to heavy strains and in all cases where a break has occurred, it has been outside of the weld. Studebaker Bros., of South Bend, Indiana, show wagon and carriage axles, from three-fourth inch round to one and one-half inch square, tires from one and one-eighth to two and one-half inch, and various sizes of hub bands, while the Kentucky Wagon Manufacturing Co., of Louisville, Ky., show sections of welded tires as large as three and three-fourth inch.; and Haydock Bros., of St. Louis, Mo., exhibit axles of all sizes and shapes.

In many cases the current has been used to heat the work for forging as well as in the weld. Schuttler & Hotz, of Chicago, have a complete set of all the sizes of hub bands used, and the New York Fifth Wheel Company, of Brooklyn, show specimens of welded channel iron in circular form for their anti-friction wheel. The Sheldon Axle Company, of Wilkesbarre, Pa., show two axles bent double at the weld. From the General Electric Company are shown various sizes and sections of welded copper wire for armatures and fields. E. C. Atkins & Co., of Indianapolis, show welded saw blades and the Richmond Cedar Works show specimens of welded wire bands for pails and tubs. Here are also steel rods from the Carnegie Steel Company, of Beaver Falls, Pa., and high carbon-steel wire from the Hazard Manufacturing Company, of Wilkesbarre, Pa., galvanized and plain wire from Washburn & Moen, of Worcester, Mass., and a telegraph wire and steel cable from the Trenton Iron Company, all welded in various ways and for various purposes, and also specimens of carriage hardware from the Sidney Pole and Shaft Company, of Sidney, Ohio, the Cortland Forging Company, of Cortland, N. Y., and M. Seward & Son, New Haven, Conn. One board contains some 2½-inch steel bars welded and tested on the testing machine at the United States Arsenal at Watertown, Mass. These all broke outside of the weld at strains of 387,000, 399,900 and 390,500 pounds, respectively.

Miscellaneous specimens of welded work are steel-wire cables with hemp centre, brass welded to iron, pieces of aluminum, steel-band saws, high grade steel edges welded to iron or low carbon steel tools, etc., agricultural wheels with hubs made in halves welded together; tires welded and spokes electrically upset on the upsetting machine already mentioned, and pipe coils, round, flat, oval, and zig-zag.

An important feature of the display is the collection of specimens from the Johnson Co., of Johnstown, Pa. Among these are combination splice bars to fasten two rails of different sections, and also a section through an electric rail in which the chair is welded directly to the rail itself. In this the chair is rolled with a bead at the top and the rail with a cup at the bottom of the web. The one fits into the other and the weld is then made. A three-way crossing is shown among these specimens having six different welds, not one of which is less than 12 square inches in cross section, and also a railroad crossing of rolled steel welded together in one solid piece. Another interesting exhibit from the same company is the largest electric weld ever made, having a section of 48 square inches.

The American Projectile Co., of Lynn, Mass., show a number of shells with highly tempered points welded on electrically. Some of these have been repeatedly fired through armor-plate. The Consolidated Storage Battery Co. have samples of elements in which the plates are electrically welded to the heads.

This necessarily somewhat statistical account of a very interesting exhibit will serve at least to show how firm a hold electric welding has taken upon the more progressive portion of the manufacturing community. With the details of electric welding machinery our readers are already familiar, but a glance at the visible results of its application cannot fail to be both striking and instructive.

Mr. F. P. Royce has had charge of the arrangement and installation of this remarkable exhibit.

THE ELECTRICITY BUILDING AT THE END OF MAY.

Considerable progress has been made during the last few days toward the completion of some of the displays, and quite a number are now ready for inspection. The general appearance of the Electricity Building is not yet very attractive, however, and (the general order that all exhibits not complete by the 14th of May should remain in an unfinished condition until the end of the Fair notwithstanding) busy workmen are about as numerous as visitors. The Westinghouse Company only commenced to take possession of their new territory about May 1st and have now set to work to rival the General Electric people, and this necessarily keeps the main floor of the building pretty well occupied. The French and German exhibits on the ground floor are also still very incomplete. The gallery, however, presents a somewhat better appearance. In the southeast end, the fine display of "Kerite" has already been described. The Billings & Spencer Company, of Hartford, Conn., have an exhibit of drop forgings in copper, bronze and aluminum; principally commutator bars of various shapes and sizes, surmounted by an immense model of the Billings patent commutator bar. Near this the Bryant Electric Company show a very well arranged board of switches, cut-outs, sockets, etc. Here also is the extensive exhibit of the Weston Instrument Company of Newark, N. J., consisting of a large booth and pavilion filled with all sorts and sizes of Weston instruments and appliances. First on the south gallery is the Du Laney Clock Company of Chicago and Valparaiso, Ind., who show electric self-winding and synchronizing clocks. These clocks differ from other forms in that the old-fashioned spring is replaced by an ordinary watch main spring wound every two minutes by an automatic electric device, insuring uniform power and a great degree of accuracy. They are also equipped with a new form of pendulum suspension preventing any irregularity from the vibration of machinery, etc. At the opposite end of the south gallery H. T. Paiste, of Philadelphia, has a striking display of switches consisting of an enormous plan or working drawing of the interior of an eccentric switch made up of a great number of real "life-size" switches fastened on a large board under a Grecian pediment. A small board on an easel at one side of the space shows the evolution of a switch from the first experiments of Mr. Paiste to the latest perfected form.

Occupying the southern end of the west gallery is the exhibit of the Edison Manufacturing Company of New York. This display is very attractively arranged and consists largely of various forms of phonographs, batteries and electrotherapeutic apparatus. The Roessler & Hasslacher Chemical Company, near by, with their well-known "Isolatine" compound both before and after its application to the wire, divide the remainder of this section with the exhibits of the Standard push-button switch, of the Electrical Specialty Company, of Denver, Col., the Hart switch, an exhibit of batteries by C. J. Hirlimann, of 17 and 19 Laight street, New York city, the India Rubber Comb Company and the Goodyear Rubber Company, who make a joint display of telephone mouth pieces, insulators, etc., and the Hope Electric Appliance Company, of Providence, R. I.

Scattered along the west gallery are several unfinished exhibits and also two or three finished ones already fully described, such as those of the Commercial Cable Company and the H. W. Johns Manufacturing Company. Beside these are the McIntosh Battery and Optical Co. of Chicago and the S. S. White Dental Co. of Philadelphia, makers of the Partz battery cells. The "Fake Department" is in this gallery, as is also a large exhibit of French pianos, and directly opposite the latter, across the northwest wall, is "Newspaper Row," a series of little offices, divided from one another by partitions and from the aisle by hangings on brass rods, and devoted to the use of the electrical press. The Ansonia Electric Co. have erected a Moorish pavilion occupying the entire north gallery and are putting in an extensive display of apparatus, including a complete electric kitchen in which object lessons in this class of cookery will be given at intervals during the day.

A large portion of the east gallery is occupied by the various exhibits of German physical and optical instruments and a very complete and interesting display showing the German telegraph and post systems. On this gallery are also the Washburn & Moen Manufacturing Co., with an imposing display of wires and cables showing all the important styles of their manufacture, the Norwich Insulated Wire Co. with their paper insulation, the National Carbon Co., showing all sorts and sizes of carbons arranged in clever and artistic forms, the New England Butt Co., manufacturers of braiding machines for covering wires, and the interesting display and working exchange of the Strowger Automatic Telephone.

In fact, one who has become familiar with the Building during the past month can see encouraging signs of an ultimate conclusion of the whole matter. While, as I have already said, the main floor still looks very bad, one can catch glimpses of finished work here and there. Some of the smaller exhibits are quite complete and many of the larger ones soon will be. Germany is making an effort, in all her displays throughout the Fair, to surpass in spectacular effect anything in sight, and, it is but the fair to add, has, at least in some cases, notably in the Manufactures Building, signally succeeded. The German exhibit in the Electricity Building, while possessing no one object so magnificent as the Tower of Light, for instance, will show, when unveiled by the removal of the scaffolding, scantling and canvas that now more than half conceal it, a certain finish and delicacy of treatment, if the expression be allowable, in reference to the mechanic arts, not noticeable in many of its neighbors. The French light-house at the north end of the building will soon be freed from its accompaniment of boards, horses and ladders, and will make a striking landmark at that end of the hall, though forming a startling anachronism with the Grecian and Egyptian temples at the other, and the recently instituted Westinghouse-General Electric rivalry all over the floor will make the building a more than ordinarily interesting spot.

It is unfortunate that accounts of this building and its contents must still, nearly a month after the opening of the Fair, be written in the future tense, but the fact remains. Work is being pushed, night and day, seven days in the week, and still the progress seems slow. There is an absence of organization and central authority among the World's Fair people that would be ludicrous were it not so serious, and that naturally affects all departments, notwithstanding splendid instances of individual effort; and defeats the very objects that everyone is trying to accomplish. As was recently said by an observant visitor, "O, that a Barnum were at the head of this show!"

WORLD'S FAIR HOSPITALITY.

The custom has obtained with many of Chicago's large mercantile establishments, of fitting up reception and refreshment rooms for the convenience of their friends and patrons. We are glad to see that the habit of being hospitable is extending. It is a pleasing thing to find some of the amenities of the home and social circle breaking through the usual set and sordid lines of commercial life. Whatever tends to interest and strengthen the relations between the man of business and his customers, is to be heartily commended. Judging from results, much the same views must be entertained by the managers of the Ansonia Electric Company. They are just completing an elaborately arranged suite of reception and club rooms, occupying the third floor of their building corner Michigan avenue and Randolph street, Chicago. Here, we understand, they have provided reading-rooms, parlor, billiard hall, writing desks, lavatories and closets, telephone and telegraph offices and private lockers for baggage and personal effects. Here the overtired traveler can rest, and get his bearings for a fresh day of sight-seeing at the Fair.

ELECTRIC RAILWAY DEPARTMENT.

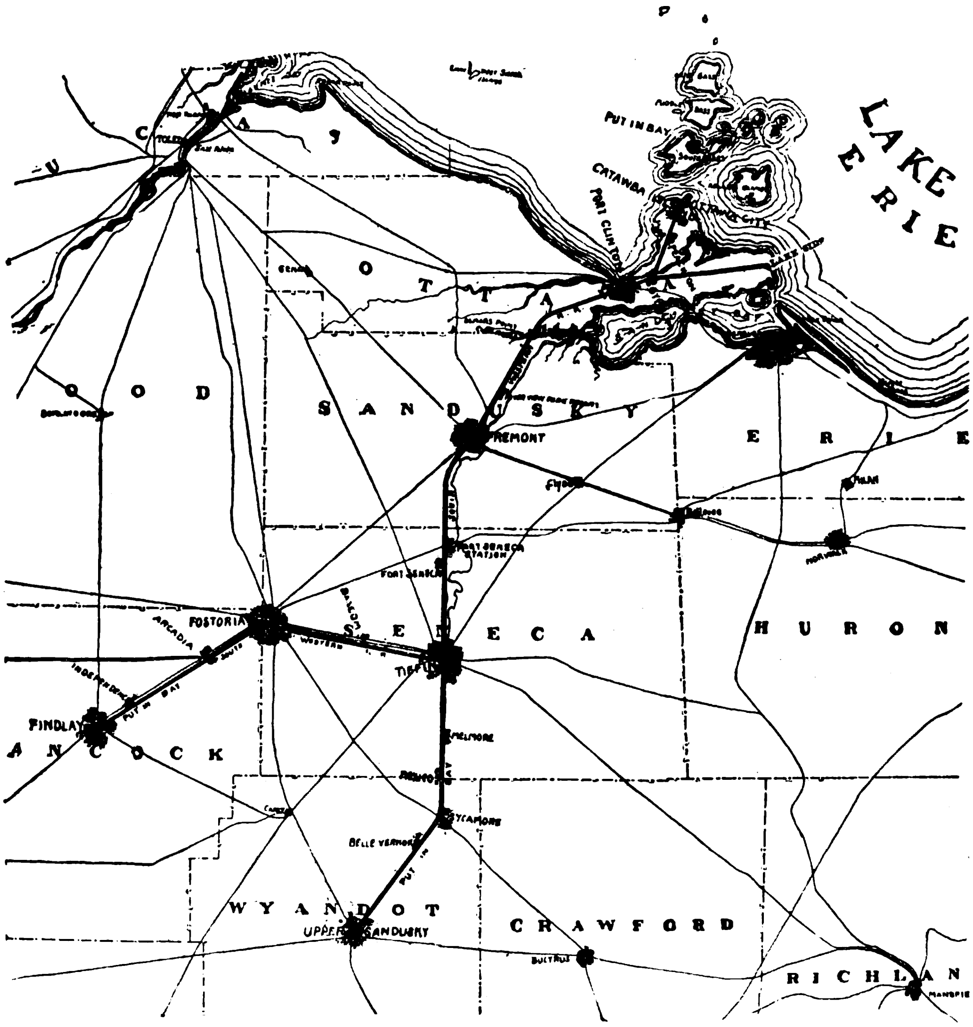
THE PUT-IN-BAY & SOUTHWESTERN ELECTRIC RAILROAD CO.

A most interesting and important electric railway project, every way feasible, is about to be carried through by the Put-in-Bay & Southwestern Electric Railroad Co. This company has been organized under the general railroad laws of the State of Ohio, with a capital of $8,000,000. The line is to be constructed under conditions of road bed and equipment sufficiently heavy to carry out all the requirements of general steam railroad business. The through cars will be double-truck, 65 feet long with a seating capacity for 100 passengers each, equipped with four 50 h. p. motors wound for a speed of 40 miles an hour. The interurban cars will be combination baggage and passenger, and equipped with two 50 h. p. motors for a speed of 30 miles an hour. The city cars will be of the usual standard with an equipment of two 25 h. p. motors.

The power stations will be three in number located at Findlay, Tiffin and Port Clinton, each station feeding about 40 miles of line, and while the system for generating and distributing the current has not been definitely selected by the company, sufficient experiments have been made to convince them that a large saving in copper and energy can be made by discarding the present low tension direct system.

The operation of this road embraces four distinct lines of trade; first, the through business which will be handled by the larger equipment, stopping only at the principal cities; second, the interurban trade which will be handled by cars running only between the cities forming the termini of its particular system but stopping anywhere along the highway; third, the city cars operated on the usual method as feeders for the other systems, and fourth, a general freight and express equipment; making in all an equipment of about 100 cars with a generating station capacity of about 4,000 h. p.

The track will be single with turnouts, constructed with 80 lb. T-rail, 2,600 ties per mile and stone ballast through its entire length. Over a very large portion of this the company has private right-of-way. The overhead line will be wired similar to a double-track line without overhead frogs and switches to retard speed.



The Electric Railway System of The Put-In-Bay & Southwestern R. R. Co.

Reference to the map will show that this line is made up of seven distinct interurban systems between cities varying from 25,000, in the case of Findlay, which is the largest, to 5,000 of Port Clinton and suburbs, which is the smallest, the other cities being Tiffin, 18,000, Fostoria, 10,000, Fremont, 10,000, Upper Sandusky Line, 11,500, Lakeside (summer 10,000, winter 3,000), the Islands (summer 20,000, winter 8,500). Besides the inhabitants of above cities, there is a large intermediate population in towns and villages along the highway.

Any one familiar with the progress and development of interurban properties will recognize at once the value of each individual system or class of business, which is, of course, increased materially by a consolidation of all these lines under one management and the consequent inter-communication of an aggregate population of 100,000 directly on its lines. To which must be added the business ticketed over this route from other electric or steam connecting lines, not reaching these points.

The summer business of this line will tax the complete equipment to accommodate the pleasure business that yearly patronizes the islands forming the historic Archipelago in Lake Erie, on one of which islands, Put-in-Bay, has been erected the largest summer resort hotel in the West; while at Lakeside, which is one of the terminals of the road, is located the "Chautauqua of the West," an assembly made up of various Christian Associations who hold there annual convention at that place.

The local lines at Tiffin and Findlay are already in operation, and contracts have been entered into for the immediate construction of the interurban roads between Tiffin and Fostoria and Fostoria and Findlay. Contracts for the remainder will be let as soon as negotiations now pending for the sale of securities are completed, and it is expected that the entire line will be in operation not later than January 1st, 1894.

The officers of the company are: George B. Kerper, Cincinnati, president; J. K. Tillotson, Toledo, secretary; R. W. Brown, Tiffin, vice-president; S. B. Sneath, Tiffin, treasurer. These are directors with S. Brinkerhoff, Fremont. Our readers will recognize most of these men as prominent and successful leaders in city electric railway enterprises. Mr. Kerper's street railway work in Cincinnati is matter of history.

THE "G. E. 800" RAILWAY MOTOR.

The accompanying engravings represent the latest type of street railway motor brought out by the General Electric Company, and which embodies all the improvements suggested by the experience of the last five years in electric railway work.

The new motor is known as the "G. E. 800." This nomenclature has been given to it as indicating its ability to exert a horizontal effort of 800 pounds through a 33-inch wheel continuously in ordinary street railway service. This rating is more accurate than that customarily employed, and adopting the General Electric Company's method of rating in horse-power, the motor becomes a 25 h. p. motor.

It is a four-pole motor of new design. Its principal characteristic and one that will recommend it especially to street railway men, is that, as claimed, it is the lightest street railway motor, for a given out-put, thus far designed. The question of preservation of tracks is one of great importance to every electric street railway company and the extent to which it usually figures on the balance sheet has created a demand for a motor light enough to reduce the wear and tear of track to a minimum. The motor in question is even lighter than the 15 h. p. motor formerly built by the General Electric Company. It is not less than 660 lbs. lighter than the old S. R. G. 15 h. p. motor, and some two or three hundred lbs. lighter than the W. P. 15 h. p.

In suspending this motor on the cross frame of the truck, it is so hung that only 500 lbs. of its weight will bear directly on the axle. From this it will readily be seen that the dead blow delivered from the axle to the track, is enormously reduced.

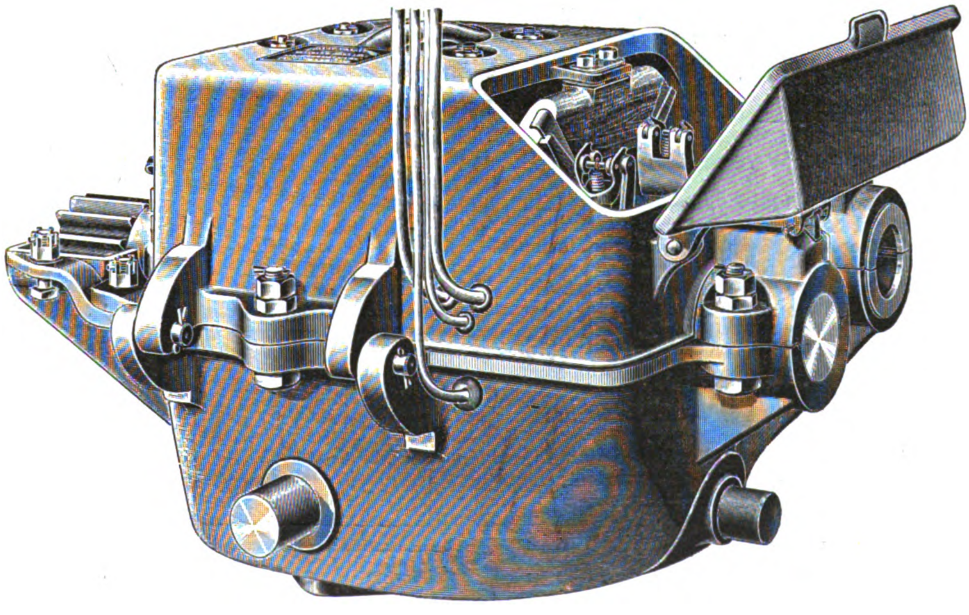


Fig. 1.—The "G. E. 800" Railway Motor.

The working parts are more easily accessible even than in the well known "W. P." motors. The aperture necessary for the purpose of inspection, cleaning, etc., is so designed that, when closed, those parts which could be damaged by water,—the brush holders, commutator, armature and field spools,—are so entirely enclosed in a watertight box, that the entire motor could be immersed in water, and still operate as under normal conditions.

This closing of the motor so as to make it water and dust-proof

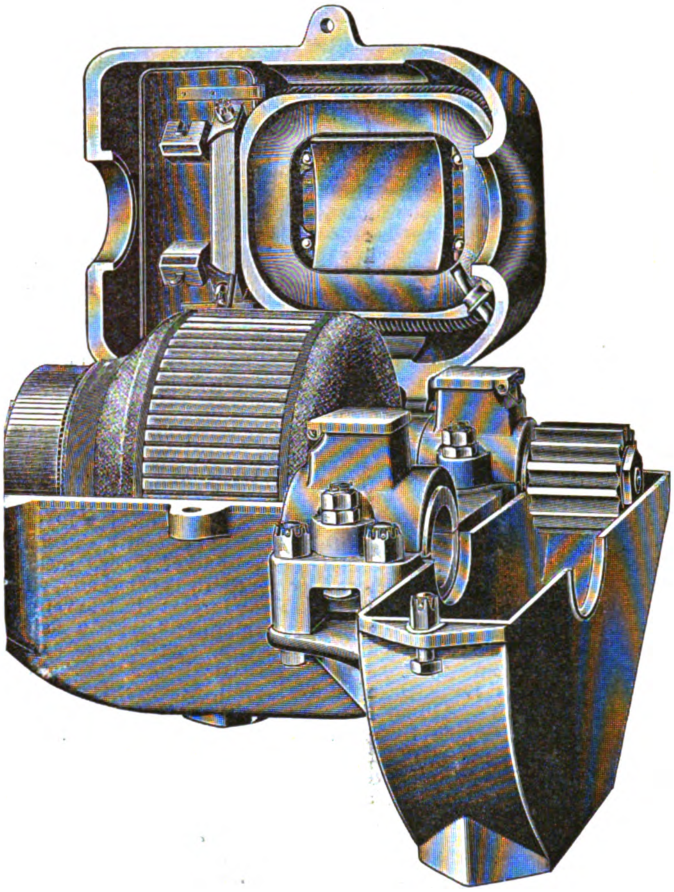


Fig. 2.—The "G. E. 800" Railway Motor.

has been rendered possible by its superior design and the liberal use of copper and the best grade of steel in its construction, whereby the heat generated in the motor has been materially reduced. It can be taken apart with the utmost facility. The top frame is hinged on to the lower frame and with its proper parts weighs only 350 lbs. On the removal of only two bolts it can be thrown back completely out of the way of the armature, or by the removal of the hinge pins the top frame can be lifted into the car; or by moving the nose plate forward the motor can be swung upon the ring axle as a hinge so as to be accessible from the pit, the top field then being swung on its hinges still lower into the pit, in which position the armature and field spools can be easily removed; or by the removal of the top of the gear case and two axle caps, the motor can be lowered as a whole into the pit. The armature is short and can be lifted through an ordinary trap door. It will thus be seen that the motor can be handled either inside the car or from without with almost equal facility. On opening the lid over the commutator easy access is had to the whole width of the commutator and brush holders, the latter being of the simplest possible construction and easily operated with one hand. There is also plenty of space to permit of the pit of the motor being reached. The bottom of the armature is two inches above the pit of the motor, so that it is not liable to be injured by articles falling inside of the motor frame. The construction is such that it is practically impossible for any grease to get inside of the motor.

The armature is similar to that used on the well-known W. P. motors and is made both in the Gramme ring and in the drum form, and they are made interchangeable. The electrical qualities of the machine have been subject to several months of stringent test under actual service conditions, with most successful results.

AN EXTENSIVE SYSTEM FOR THE JERSEY COAST.

A SPECIAL dispatch from Asbury Park, N. J., of May 19, says:—Lawyer Isaac C. Kennedy of this place will file with the county clerk at Freehold, N. J., to-morrow, articles of incorporation of the Monmouth County Seashore Electric Railway Company, which proposes to build and operate one of the largest electric railways in this country. The company will start out with a paid-up capital of $1,500,000, and will at once begin work on a road extending from Pleasure Bay, near Long Branch, to Point Pleasant, passing through Long Branch, West End, Elberon, Deal Beach, Loch Arbor, North Asbury Park, Asbury Park, Ocean Grove, Key East, Belmar, Spring Lake, Como, and Point Pleasant. J. C. Shafer, the president of the Seashore Electric Railway of this place and the owner of several large electric railways, is at the head of the new company, and has associated with him six prominent railroad men, whose names are withheld by Mr. Kennedy until the papers are placed on file. The new company has already leased the Byrnes Building, at this place, as its headquarters, and will, in all probability, purchase it and make it a central station. Three operating stations are to be created along the proposed route, besides the one at this place which the new company will purchase. The overhead trolley system will be used.

A LONG ROAD FOR TEXAS.

THE project for an electric railroad between Fort Worth, Tex., and Dallas, 23 miles, is given a solid basis by the reorganization of the Dallas and Oak Cliffe Road, and within six months trains will, it is said, be running between the two places.

AN EXTENSIVE NETWORK IN NEW YORK'S SUBURBS.

THE UNION ELECTRIC RAILWAY of this city, has completed an arrangement whereby it becomes the possessor of the entire lines of the Westchester Electric company. The lines of the latter company when completed, will operate from the Hudson River to Long Island Sound through the city, while the Union Road will extend its present system from Fordham, meeting and connecting with the newly acquired line at Woodlawn. It is stated that the Union Company has acquired title to all of the lines operated in the lower part of the county, namely, the White Plains and Port Chester lines. President Thomas E. Crimmins has appointed John S. Ryan, of New Rochelle, superintendent of the consolidated lines.

It is generally understood that John D. Crimmins is at the head of the consolidated company. The work of connecting the lines will be pushed to completion as soon as possible.

RAILWAY EQUIPMENT COMPANY.

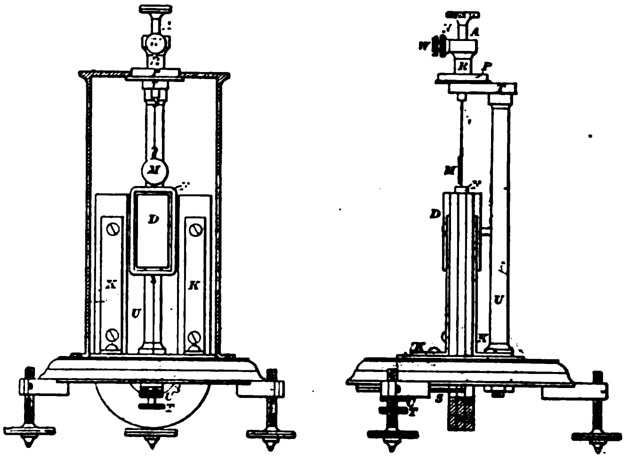
A NEW catalogue of its electric railway supplies has been issued by the above company from its headquarters in the Pullman Building, Chicago. It is a massive publication of 208 pages, very well arranged, and including every article of use in railway work. It is profusely illustrated, and is supplemented by several tables and a paper on the leading features of railway work by Mr. W. R. B. Willcox. General manager W. R. Mason is to be congratulated on this issue.

MISCELLANEOUS.

A MODIFIED DEPREZ-D'ARSONVAL GALVANOMETER.[1]

BY LIEUT. CH. D. PARKHURST.

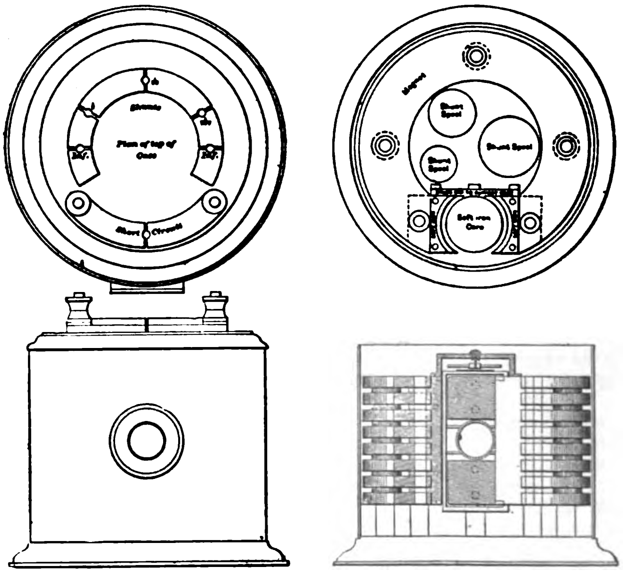
IN this paper the author describes an instrument designed by him in which are introduced several modifications from the usual construction of this type. The engravings, Figs. 1 and 2, show the instrument in front and side elevation. The arrangement is such that the current has to flow through the suspension. To this end the coil frame is suspended between the top hook T and the bottom hook upon the tension spring S.



FIGS. 1 AND 2.—PARKHURST MODIFIED DEPREZ-D'ARSONVAL GALVANOMETER.

The wire used for the suspension is of the utmost importance; upon this depends in a great measure the "dead beat" qualities of the instrument. For such a coil as that described, wire as fine as .003 in. was used, and a true "dead beat" galvanometer was the result. The instrument is extremely delicate, but lacks in ready portability owing to the delicacy of the suspension.

In order to adapt the Weston type of instruments to reading by mirror instead of index and thereby to secure greater accuracy, the author has constructed the instrument shown in Figs. 3 and 4. The magnet is made circular and compound with soft iron pole pieces, similar to the arrangement in the Pitkin form of D'Arsonval instrument; but in place of the wire suspension of that instrument the steel pinion and pivoted centres of the Weston



FIGS. 3 AND 4.

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[1] Abstract of a Paper read before the American Institute of Electrical Engineers, May 17, 1893.

form, with the double hair springs, is adopted. The mirror turns with the coil. A window, as shown, is provided in the case, to allow the movements of the mirror to be observed. This window can have a brass cap or cover to slip on to protect the glass in transportation. The bottom and top of the case are of hard rubber, the side of the case is thin brass tubing; in the case, in the space within the bend of the magnet, a set of shunt coils may be inserted, with terminal blocks on the top of the case; the binding posts are upon the top, and a short-circuit may be provided, as shown.

The author draws attention to the lack of information regarding the data of construction of American instruments. While the makers sometimes give the resistance of a high-class galvanometer they rarely if ever give the far more important data referring to the number of turns of wire in each coil, or their mean radii. Foreign and particularly German instruments are generally accompanied by this information.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.[1]—I.

BY NIKOLA TESLA.

INTRODUCTORY.—SOME THOUGHTS ON THE EYE.

WHEN we look at the world around us, on Nature, we are impressed with its beauty and grandeur. Each thing we perceive, though it may be vanishingly small, is in itself a world, that is, like the whole of the visible universe, matter and force governed by law,—a world, the contemplation of which fills us with feelings of wonder and irresistibly urges us to ceaseless thought and inquiry. But in all this vast world, of all objects our senses reveal to us, the most marvellous, the most appealing to our imagination, appears no doubt a highly developed organism, a thinking being. If there is anything fitted to make us admire Nature's handiwork, it is certainly this inconceivable structure, which performs its innumerable motions in obedience to external influence. To understand its workings, to get a deeper insight into this Nature's masterpiece, has ever been for thinkers a fascinating aim, and after many centuries of arduous research men have arrived at a fair understanding of the functions of its organs and senses. Again, in all the perfect harmony of its parts, of the parts which constitute the material or tangible of our being, of all its organs and senses, the eye is the most wonderful. It is the most precious, the most indispensable of our receptive or directive organs, it is the great gateway through which all knowledge enters the mind. Of all our organs, it is the one, which is in the most intimate relation with that which we call intellect. So intimate is this relation, that it is often said, that the very soul shows itself in the eye.

It can be taken as a fact, which the theory of the action of the eye implies, that for each external impression, that is, for each image produced upon the retina, the ends of the visual nerves, concerned in the conveyance of the impression to the mind, must be under a peculiar stress or in a vibratory state. It now does not seem improbable that, when by the power of thought an image is evoked, a distinct reflex action, no matter how weak, is exerted upon certain ends of the visual nerves, and therefore upon the retina. Will it ever be within human power to analyze the condition of the retina when disturbed by thought or reflex action, by the help of some optical or other means of such sensitiveness, that a clear idea of its state might be gained at any time? If this were possible, then the problem of reading one's thoughts with precision, like the characters of an open book, might be much easier to solve than many problems, belonging to the domain of positive physical science, in the solution of which many, if not the majority, of scientific men implicitly believe. Helmholtz has shown that the fundi of the eyes are themselves luminous, and he was able to *see*, in total darkness, the movement of his arm by the light of his own eyes. This is one of the most remarkable experiments recorded in the history of science, and probably only a few men could satisfactorily repeat it, for it is very likely, that the luminosity of the eyes is associated with uncommon activity of the brain and great imaginative power. It is fluorescence of brain action, as it were.

Another fact having a bearing on this subject which has probably been noted by many, since it is stated in popular expressions, but which I cannot recollect to have found chronicled as a positive result of observation is, that at times, when a sudden idea or image presents itself to the intellect, there is a distinct and sometimes painful sensation of luminosity produced in the eye, observable even in broad daylight.

The saying then, that the soul shows itself in the eye, is deeply founded, and we feel that it expresses a great truth. It has a profound meaning even for one who, like a poet or artist, only following his inborn instinct or love for Nature, finds delight in aimless thoughts and in the mere contemplation of natural phenomena, but a still more profound meaning for one who, in the spirit of positive scientific investigation, seeks to ascertain the causes of the effects. It is principally the natural philosopher, the physicist, for whom the eye is the subject of the most intense admiration.

Two facts about the eye must forcibly impress the mind of the physicist, notwithstanding he may think or say that it is an imperfect optical instrument, forgetting, that the very conception of that which is perfect or seems so to him, has been gained through this same instrument. Firstly, the eye is, as far as our positive knowledge goes, the only organ which is *directly* affected by that subtile medium, which as science teaches us, must fill all space; secondly, it is the most sensitive of our organs, incomparably more sensitive to external impressions than any other.

The organ of hearing implies the impact of ponderable bodies, the organ of smell the transference of detached material particles, and the organs of taste, and of touch or force, the direct contact, or at least some interference of ponderable matter, and this is true even in those instances of animal organisms, in which some of these organs are developed to a degree of truly marvelous perfection. This being so, it seems wonderful that the organ of sight solely should be capable of being stirred by that, which all our other organs are powerless to detect, which yet plays an essential part in all natural phenomena, which transmits all energy and sustains all motion and, that most intricate of all, life, but which has properties such that even a scientifically trained mind cannot help drawing a distinction between it and all that is called matter. Considering merely this, and the fact that the eye, by its marvelous power, widens our otherwise very narrow range of perception far beyond the limits of the small world which is our own, to embrace myriads of other worlds, suns and stars in the infinite depths of the universe, would make it justifiable to assert, that it is an organ of a higher order. Its performances are beyond comprehension. Nature as far as we know never produced anything more wonderful. We can get barely a faint idea of its prodigious power by analyzing what it does and by comparing. When ether waves impinge upon the human body, they produce the sensations of warmth or cold, pleasure or pain, or perhaps other sensations of which we are not aware, and any degree or intensity of these sensations, which degrees are infinite in number, hence an infinite number of distinct sensations. But our sense of touch, or our sense of force, cannot reveal to us these differences in degree or intensity, unless they are very great. Now we can readily conceive how an organism, such as the human in the eternal process of evolution, or more philosophically speaking, adaptation to Nature, being constrained to the use of only the sense of touch or force, for instance, might develop this sense to such a degree of sensitiveness or perfection, that it would be capable of distinguishing the minutest differences in the temperature of a body even at some distance, to a hundredth, or thousandth, or millionth part of a degree. Yet, even this apparently impossible performance would not begin to compare with that of the eye, which is capable of distinguishing and conveying to the mind in a single instant innumerable peculiarities of the body, be it in form or color or other respects. This power of the eye rests upon two things, namely, the rectilinear propagation of the disturbance by which it is affected, and upon its sensitiveness. To say that the eye is sensitive is not saying anything. Compared with it, all other organs are monstrously crude. The organ of smell which guides a dog on the trail of a deer, the organ of touch or force which guides an insect in its wanderings, the organ of hearing, which is affected by the slightest disturbances of the air, are sensitive organs, to be sure, but what are they compared with the human eye! No doubt it responds to the faintest echoes or reverberations of the medium; no doubt, it brings us tidings from other worlds, infinitely remote, but in a language we cannot as yet always understand. And why not? Because we live in a medium filled with air and other gases, vapors and a dense mass of solid particles flying-about. These play an important part in many phenomena; they fritter away the energy of the vibrations before they can reach the eye; they too, are the carriers of germs of destruction, they get into our lungs and other organs, clog up the channels and imperceptibly, yet inevitably arrest the stream of life. Could we but do away with all ponderable matter in the line of sight of the telescope, it would reveal to us undreamt of marvels. Even the unaided eye, I think, would be capable of distinguishing in the pure medium, small objects at distances measured probably by hundreds or perhaps thousands of miles.

But there is something else about the eye which impresses us still more than these wonderful features which we observe, viewing it from the standpoint of a physicist, merely as an optical instrument,—something which appeals to us more than its marvelous faculty of being directly affected by the vibrations of the medium, without interference of gross matter, and more than its inconceivable sensitiveness and discerning power. It is its significance in the processes of life. No matter what one's views on Nature and life may be, he must stand amazed when, for the first time in his thoughts, he realizes the importance of the eye in the physical processes and mental performances of the human organism. And how could it be otherwise, when he realizes, that the eye is the means through which the human race has acquired the entire knowledge it possesses, that it controls all our motions, more still, all our actions.

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[1] A lecture delivered before the Franklin Institute, at Philadelphia, Feb. 24, 1893, and before the National Electric Light Association, at St. Louis, Mo., March 1, 1893.

There is no way of acquiring knowledge except through the eye. What is the foundation of all philosophical systems of ancient and modern times, in fact of all the philosophy of man? *I am, I think; I think, therefore I am.* But how could I think and how would I know that I exist, if I had not the eye? For knowledge involves consciousness; consciousness involves ideas, conceptions; conceptions involve pictures or images, and images, the sense of vision, and therefore the organ of sight. But how about blind men, will be asked? Yes, a blind man may depict in magnificent poems forms and scenes from real life, from a world he physically does not see. A blind man may touch the keys of an instrument with unerring precision, may build the fastest boat, may discover and invent, calculate and construct, may do still greater wonders,—but all the blind men who have done such things have descended from those who had seeing eyes. Nature may reach the same result in many ways. Like a wave in the physical world, in the infinite ocean of the medium which pervades all, so in the world of organisms, in life, an impulse started proceeds onward, at times, may be, with the speed of light, at times, again, so slowly that for ages and ages it seems to stay, passing through processes of a complexity inconceivable to men, but in all its forms, in all its stages, its energy ever and ever integrally present. A single ray of light from a distant star falling upon the eye of a tyrant in bygone times, may have altered the course of his life, may have changed the destiny of nations, may have transformed the surface of the globe, so intricate, so inconceivably complex are the processes in Nature. In no way can we get such an overwhelming idea of the grandeur of Nature, as when we consider, that in accordance with the law of the conservation of energy, throughout the Infinite, the forces are in a perfect balance, and hence the energy of a single thought may determine the motion of a Universe. It is not necessary that every individual, not even that every generation or many generations, should have the physical instrument of sight, in order to be able to form images and to think, that is, form ideas or conceptions; but sometime or other, during the process of evolution, the eye certainly must have existed, else thought, as we understand it, would be impossible; else conceptions, like spirit, intellect, mind, call it as you may, could not exist. It is conceivable, that in some other world, in some other beings the eye is replaced by a different organ, equally or more perfect, but these beings cannot be men.

Now what prompts us to all voluntary motions and actions of any kind? Again the eye. If I am conscious of the motion, I must have an idea or conception, that is, an image, therefore the eye. If I am not precisely conscious of the motion, it is, because the images are vague or indistinct, being blurred by the superimposition of many. But when I perform the motion, does the impulse which prompts me to the action come from within or from without? The greatest physicists have not disdained to endeavor to answer this and similar questions and have at times abandoned themselves to the delights of pure and unrestrained thought. Such questions are generally considered not to belong to the realm of positive physical science, but will before long be annexed to its domain. Helmholtz has probably thought more on life than any modern scientist. Lord Kelvin expressed his belief that life's process is electrical and that there is a force inherent to the organism and determining its motions. Just as much as I am convinced of any physical truth I am convinced that the motive impulse must come from the outside. For, consider the lowest organism we know—and there are probably many lower ones—an aggregation of a few cells only. If it is capable of voluntary motion it can perform an infinite number of motions, all definite and precise. But now a mechanism consisting of a finite number of parts and few at that, cannot perform an infinite number of definite motions, hence the impulses which govern its movements must come from the environment. So, the atom, the ulterior element of the Universe's structure, is tossed about in space eternally, a play to external influences, like a float in a troubled sea. Were it to stop its motion *it would die.* Matter at rest, if such a thing could exist, would be matter dead. Death of matter! Never has a sentence of deeper philosophical meaning been uttered. This is the way in which Prof. Dewar forcibly expresses it in the description of his admirable experiments, in which liquid oxygen is handled as one handles water, and air at ordinary pressure is made to condense and even to solidify by the intense cold. Experiments, which serve to illustrate, in his language, the last feeble manifestations of life, the last quiverings of matter about to die. But human eyes shall not witness such death. There is no death of matter, for throughout the infinite universe, all has to move, to vibrate, that is, to live.

I have made the preceding statements at the peril of treading upon metaphysical ground in my desire to introduce the subject of this lecture in a manner not altogether uninteresting, I may hope, to an audience such as I have the honor to address. But now then, returning to the subject, this divine organ of sight, this indispensable instrument for thought and all intellectual enjoyment, which lays open to us the marvels of this universe, through which we have acquired what knowledge we possess, and which prompts us to, and controls, all our physical and mental activity, By what is it affected? By light! What is light?

We have witnessed the great strides which have been made in all departments of science in recent years. So great have been the advances that we cannot refrain from asking ourselves, Is this all true, or is it but a dream? Centuries ago men have lived, have thought, discovered, invented, and have believed that they were soaring, while they were merely proceeding at a snail's pace. So we too may be mistaken. But taking the truth of the observed events as one of the implied facts of science, we must rejoice in the immense progress already made and still more in the anticipation of what must come, judging from the possibilities opened up by modern research. There is, however, an advance which we have been witnessing, which must be particularly gratifying to every lover of progress. It is not a discovery, or an invention, or an achievement in any particular direction. It is an advance in all directions of scientific thought and experiment. I mean the generalization of the natural forces and phenomena, the looming up of a certain broad idea on the scientific horizon. It is this idea which has, however, long ago taken possession of the most advanced minds, to which I desire to call your attention, and which I intend to illustrate, in a general way, in these experiments, as the first step in answering the question "What is light?" and to realize the modern meaning of this word.

It is beyond the scope of my lecture to dwell upon the subject of light in general, my object being merely to bring presently to your notice a certain class of light effects and a number of phenomena observed in pursuing the study of these effects. But to be consistent in my remarks it is necessary to state that according to that idea, now accepted by the majority of scientific men as a positive result of theoretical and experimental investigation, the various forms or manifestations of energy which were generally designated as "electric" or more precisely "electromagnetic" are energy manifestations of the same nature as those of radiant heat and light. Therefore the phenomena of light and heat, and others besides these, may be called electrical phenomena. Thus electrical science has become the mother science of all and its study has become all important. The day when we shall know exactly what "electricity" is, will chronicle an event probably greater, more important than any other recorded in the history of the human race. The time will come when the comfort, the very existence perhaps of man will depend upon that wonderful agent. For our existence and comfort we require heat, light and mechanical power. How do we now get all these? We get them from fuel, we get them by consuming material. What will man do when the forests disappear, when the coal fields are exhausted? Only one thing, according to our present knowledge will remain; that is, to transmit power at great distances. Men will go the waterfalls, to the tides, which are the stores of an infinitesimal part of Nature's immeasurable energy. There will they harness the energy and transmit the same to their settlements, to warm their homes by, to give them light, and to keep their obedient slaves, the machines, toiling. But how will they transmit this energy if not by electricity? Judge then, if the comfort, nay, the very existence, of man will not depend on electricity. I am aware that this view is not that of a practical engineer, but neither is it that of an illusionist, for it is certain, that power transmission which at present is merely a stimulus to enterprise, will some day be a dire necessity.

It is more important for the student, who takes up the study of light phenomena, to make himself thoroughly acquainted with certain modern views, than to peruse entire books on the subject of light itself, as disconnected from these views. Were I therefore to make these demonstrations before students seeking information—and for the sake of the few of those who may be present, give me leave to so assume—it would be my principal endeavor to impress these views upon their minds in this series of experiments.

It might be sufficient for this purpose to perform a simple and well-known experiment. I might take a familiar appliance, a Leyden jar, charge it from a frictional machine, and then discharge it. In explaining to you its permanent state when charged, and its transitory condition when discharging, calling your attention to the forces which enter into play and to the various phenomena they produce, and pointing out the relation of the forces and phenomena, I might fully succeed in illustrating that modern idea. No doubt, to the thinker, this simple experiment would appeal as much as the most magnificent display. But this is to be an experimental demonstration, and one which should possess besides instructive, also entertaining features and as such, a simple experiment, such as the one cited, would not go very far towards the attainment of the lecturer's aim. I must therefore choose another way of illustrating, more spectacular certainly, but perhaps also more instructive. Instead of the frictional machine and Leyden jar, I shall avail myself in these experiments, of an induction coil of peculiar properties, which was described in detail by me in a lecture before the London Institution of Electrical Engineers, in Feb., 1892. This induction coil is capable of yielding currents of enormous potential differences, alternating with extreme rapidity. With this apparatus I shall endeavor to show you three distinct classes of effects, or phenomena, and it is my desire that each experiment, while serving for the purposes of illustration, should at the same time teach us some novel truth, or show us some novel aspect of this fascinating science. But before doing this, it seems proper and useful to dwell upon the apparatus employed, and method of obtaining the high potentials and high-frequency currents which are made use of in these experiments.

ON THE APPARATUS AND METHOD OF CONVERSION.

These high-frequency currents are obtained in a peculiar manner. The method employed was advanced by me about two years ago in an experimental lecture before the American Institute of Electrical Engineers. A number of ways, as practiced in the laboratory, of obtaining these currents either from continuous or low frequency alternating-currents is diagramatically indicated in Fig. 1, which will be later described in detail. The general plan is to charge condensers, from a direct or alternate-current source, preferably of high-tension, and to discharge them disruptively while observing well-known conditions necessary to maintain the oscillations of the current. In view of the general interest taken in high-frequency currents and effects producible by them, it seems to me advisable to dwell at some length upon this method of conversion. In order to give you a clear idea of the action, I will suppose that a continuous-current generator is employed, which is often very convenient. It is desirable that the generator should possess such high tension as to be able to break through a small air space. If this is not the case, then auxiliary means have to be resorted to, some of which will be indicated subsequently. When the condensers are charged to a certain potential, the air or insulating space gives way and a disruptive discharge occurs. There is then a sudden rush of current and generally a large portion of the accumulated electrical energy spends itself. The condensers are thereupon quickly charged and the same process is repeated in more or less rapid succession. To produce such sudden rushes of current it is necessary to observe certain conditions. If the rate at which the condensers are discharged is the same as that at which they are charged, then, clearly, in the assumed case the condensers do not come into play. If the rate of discharge be smaller than the rate of charging, then, again, the condensers cannot play an important part. But if, on the contrary, the rate of discharging is greater than that of charging, then a succession of rushes of current is obtained. It is evident that, if the rate at which the energy is being dissipated by the discharge is very much greater than the rate of supply to the condensers, the sudden rushes will be comparatively few, with long-time intervals between. This always occurs when a condenser of considerable capacity is charged by means of a comparatively small machine. If the rates of supply and dissipation are not widely different, then the rushes of current will be in quicker succession, and this the more, the more nearly equal both the rates are, until natural limitations incident to each case and depending upon a number of causes are reached. Thus we are able to obtain from a continuous-current generator as rapid a succession of discharges as we like. Of course, the higher the tension of the generator, the smaller need be the capacity of the condensers, and for this reason, principally, it is of advantage to employ a generator of very high tension. Besides, such a generator permits the attaining of greater rates of vibration.

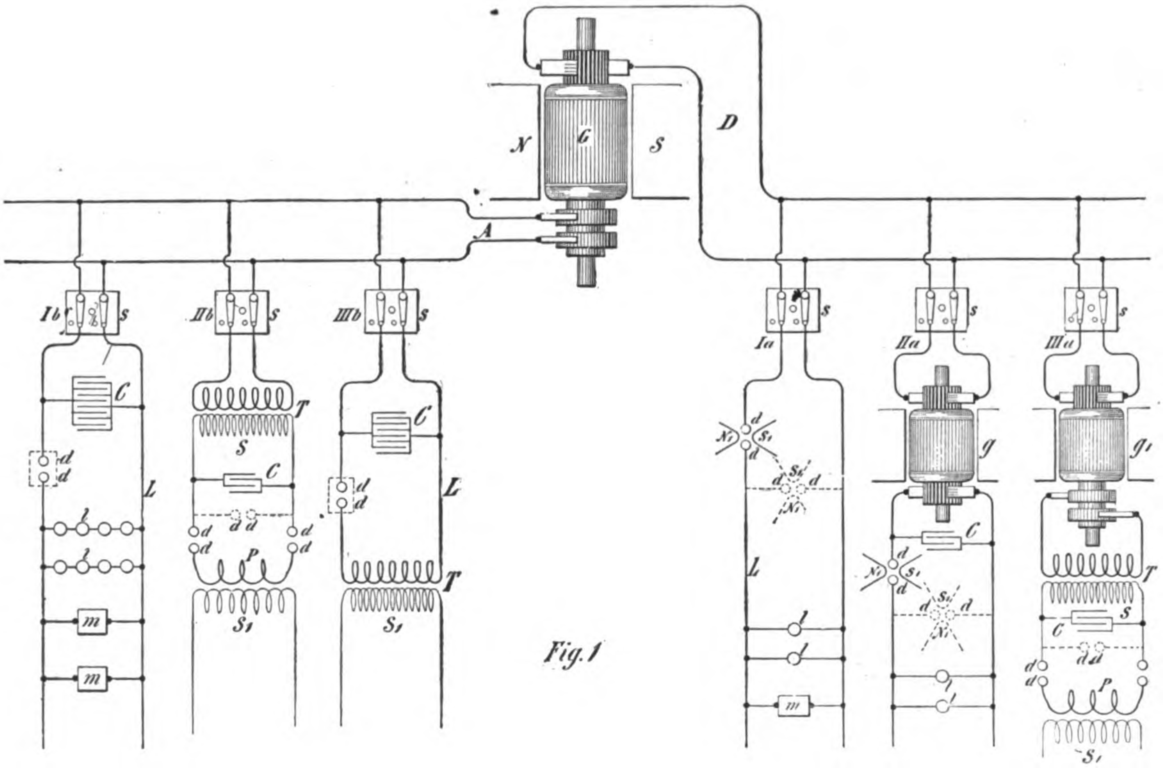


FIG. 1.—PLAN OF CONNECTIONS USED IN THE CONVERSION BY MEANS OF THE DISRUPTIVE ARC DISCHARGE.

The rushes of current may be of the same direction under the conditions before assumed, but most generally there is an oscillation superimposed upon the fundamental vibration of the current. When the conditions are so determined that there are no oscillation, the current impulses are unidirectional and thus a means is provided of transforming a continuous current of high tension into a direct current of lower tension, which I think may find employment in the arts.

This method of conversion is exceedingly interesting and I was much impressed by its beauty when I first conceived it. It is ideal in certain respects. It involves the employment of no mechanical devices of any kind, and it allows of obtaining currents of any desired frequency from an ordinary circuit, direct or alternating. The frequency of the fundamental discharges depending on the relative rates of supply and dissipation can be readily varied within wide limits by simple adjustments of these quantities, and the frequency of the superimposed vibration by the determination of the capacity, self-induction and resistance of the circuit. The potential of the currents, again, may be raised as high as any insulation is capable of withstanding safely by combining capacity and self-induction or by induction in a secondary, which need have but comparatively few turns.

As the conditions are often such that the intermittence or oscillation does not readily establish itself, especially when a direct current source is employed, it is of advantage to associate an interrupter with the arc, and I have, some time ago, indicated the use of an air-blast or magnet, or other such device readily at hand. The magnet is employed with special advantage in the conversion of direct currents, as it is then very effective. If the primary source is an alternate current generator, it is desirable, as I have stated on another occasion, that the frequency should be low, and that the currents forming the arc be large, in order to render the magnet more effective.

A form of such discharger with a magnet which has been found convenient, and adopted after some trials, in the conversion of direct currents particularly, is illustra'ed in Fig. 2. N S are the pole pieces of a very strong magnet which is excited by a coil C. The pole pieces are slotted for adjustment and can be fastened in any position by screws s_1 s_1. The discharge rods d d_1 thinned down on the ends in order to allow a closer approach of the magnetic pole pieces, pass through the columns of brass b b_1 and are fastened in position by screws s_2 s_2. Springs r r_1 and collars c c_1 are slipped on the rods, the latter serving to set the points of the rods at a certain suitable distance by means of screws s_2 s_3, and the former to draw the points apart. When it is desired to start the arc, one of the hard rubber handles h h_1 is tapped quickly with the hand, whereby the points of the rods are brought in contact but are instantly separated by the springs r r_1. Such an arrangement has been found to be often necessary, namely in cases when the E. M. F. was not large enough to cause the discharge to break through the gap, and also when it was desirable to avoid short circuiting of the generator by the metallic contact of the rods. The rapidity of the interruptions of the current with a magnet depends on the intensity of the magnetic field and on the potential difference at the ends of the arc. The interruptions are generally in such quick succession as to produce a musical sound. Years ago it was observed that when a powerful induction coil is discharged between the poles of a strong magnet the discharge produced a loud noise not unlike a small pistol shot. It was vaguely stated that the spark was intensified by the presence of the magnetic field. It is now clear that the discharge current, flowing for some time, was interrupted a great number of times by the magnet, thus producing the sound. The phenomenon is especially marked when the field circuit of a large magnet or dynamo is broken in a powerful magnetic field.

When the current through the gap is comparatively large, it is of advantage to slip on the points of the discharge rods pieces of very hard carbon and let the arc play between the carbon pieces. This preserves the rods and besides has the advantage of keeping the air space hotter, as the heat is not conducted away as quickly through the carbons, and the result is that a smaller E. M. F. in the arc gap is required to maintain a succession of discharges.

The air may be rendered dielectrically weak also by rarefaction. Dischargers of this kind have likewise been used by me in connection with the magnet. A large tube is for this purpose provided with heavy electrodes of carbon or metal, between which the discharge is made to pass, the tube being placed in a powerful magnetic field. The exhaustion of the tube is carried to a point at which the discharge breaks through easily, but the pressure should be more than 75 millimetres, at which the ordinary thread discharge occurs. In another form of discharger, combining the features before mentioned, the discharge was made to pass between two adjustable magnetic pole pieces, the space between them being kept at an elevated temperature.

It should be remarked here that when such, or interrupting devices of any kind, are used and the currents are passed through the primary of a disruptive discharge coil, it is not, as a rule, of advantage to produce a number of interruptions of the current per second greater than the natural frequency of vibration of the dynamo supply circuit, which is ordinarily small. It should also be pointed out here, that while the devices mentioned in connection with the disruptive discharge are advantageous under certain conditions, they may be sometimes a source of trouble, as they produce intermittences and other irregularities in the vibration which it would be very desirable to overcome.

There is, I regret to say, in this beautiful method of conversion a defect, which fortunately is not vital, and which I have been gradually overcoming. I will best call attention to this defect and indicate a fruitful line of work by comparing the electrical process with its mechanical analogue. The process may be illustrated in this manner. Imagine a tank with a wide opening at the bottom, which is kept closed by spring pressure, but so that it snaps off *suddenly* when the liquid in the tank has reached a certain height. Let the fluid be supplied to the tank by means of a pipe feeding at a certain rate. When the critical height of the liquid is reached, the spring gives way and the bottom of the tank drops out. Instantly the liquid falls through the wide opening, and the spring, reasserting itself, closes the bottom again. The tank is now filled, and after a certain time interval the same process is repeated. It is clear, that if the pipe feeds the fluid quicker than the bottom outlet is capable of letting it pass through, the bottom will remain off and the tank will still overflow. If the rates of supply are exactly equal, then the bottom lid will remain partially open and no vibration of the same and of the liquid column will generally occur, though it might, if started by some means. But if the inlet pipe does not feed the fluid fast enough for the outlet, then there will be always vibration. Again, in such case, each time the bottom flaps up or down, the spring and the liquid column, if the pliability of the spring and the inertia of the moving parts are properly chosen, will perform independent vibrations. In this analogue the fluid may be likened to electricity or electrical energy, the tank to the condenser, the spring to the dielectric and the pipe to the conductor through which electricity is supplied to the condenser. To make this analogy quite complete it is necessary to make the assumption, that the bottom, each time it gives way, is knocked violently against a non-elastic stop, this impact involving some loss of energy, and that, besides, some dissipation of energy results, due to frictional losses. In the preceding analogue the liquid is supposed to be under a steady pressure. If the pressure of the fluid be assumed to vary rhythmically, this may be taken as corresponding to the case of an alternating current. The process is then not quite as simple to consider, but the action is the same in principle.

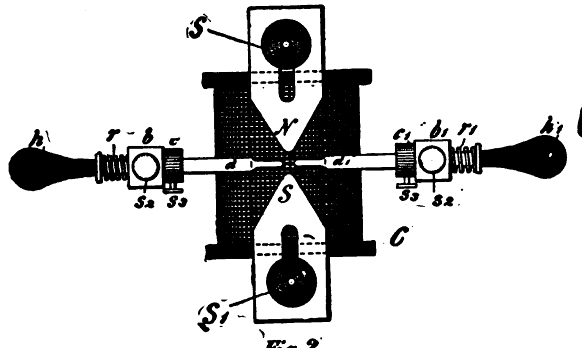


Fig. 2.

FIG. 2.—FORM OF DISCHARGER WITH MAGNET USED IN THE DIRECT CURRENT CONVERSION.

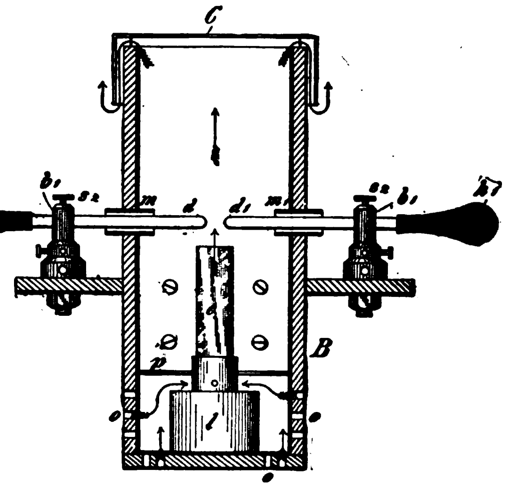


Fig. 3.

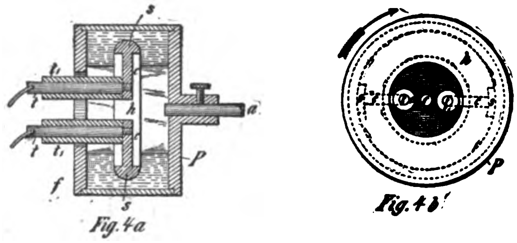
FIG. 3.—DISCHARGER WITH HOT AIR DRAFT.

Another form of discharger which may be employed with advantage in some cases is illustrated in Fig. 3. In this form the discharge rods d d_1 pass through perforations in a wooden box B, which is thickly coated with mica on the inside, as indicated by the heavy lines. The perforations are provided with mica tubes m m_1 of some thickness, which are preferably not in contact with the rods d d_1. The box has a cover C which is a little larger and descends on the outside of the box. The spark gap is warmed by a small lamp l contained in the box. A plate p above the lamp allows the draught to pass only through the chimney c of the lamp, the air entering through holes o o in or near the bottom of the box and following the path indicated by the arrows. When the discharger is in operation the door of the box is closed so that the light of the arc is not visible outside. It is desirable to exclude the light as perfectly as possible, as it interferes with some experiments. This form of discharger is simple and very effective when properly manipulated. The air being warmed to a certain temperature has its insulating power impaired, it becomes dielectrically weak, as it were, and the consequence is that the arc can be established at much greater distance. The air should, of course, be sufficiently insulating to allow the discharge to pass through the gap *disruptively*. The arc formed under such conditions, when long, may be made extremely sensitive, and the weak draught through the lamp chimney c is quite sufficient to produce rapid interruptions. The adjustment is made by regulating the temperature and velocity of the draught. Instead of using a lamp it answers the purpose to provide for a draught of warm air in other ways. A very simple way which has been practiced is to inclose the arc in a long vertical tube with plates on the top and bottom for regulating the temperature and velocity of the air current. Some provision had to be made for deadening the sound.

It is desirable, in order to maintain the vibration economically, to reduce the impact and frictional losses as much as possible. As regards the latter, which in the electrical analogue correspond to the losses due to the resistance of the circuits, it is impossible to obviate them entirely, but they can be reduced to a minimum by a proper selection of the dimensions of the circuits and by the employment of thin conductors in the form of strands. But the loss of energy caused by the first breaking through of the dielectric—which in the above example corresponds to the violent knock of the bottom against the inelastic stop—would be more important to overcome. At the moment of the breaking through, the air space has a very high resistance, which is probably reduced to a very small value when the current has reached some strength, and the space is brought to a high temperature. It would materially diminish the loss of energy, if the space were always kept at an extremely high temperature, but then there would be no disruptive break. By warming the space moderately by means of a lamp or otherwise, the economy as far as the arc is concerned is sensibly increased. But the magnet or other interrupting device does not diminish the loss in the arc. Likewise, a jet of air only facilitates the carrying off of the energy. Air, or a gas in general, behaves curiously in this respect When two bodies, charged to a very high potential, discharge disruptively through an air space, any amount of energy may be carried off by the air. This energy is evidently dissipated by bodily carriers, in impact and collisional losses of the molecules. The exchange of the molecules in the space occurs with inconceivable rapidity. A powerful discharge taking place between two electrodes, they may remain entirely cool, and yet the loss in the air may represent any amount of energy. It is perfectly practicable, with very great potential differences in the gap, to dissipate several horse-power in the arc of the discharge without even noticing a small increase in the temperature of the electrodes. All the frictional losses occur then practically in the air. If the exchange of the air molecules is prevented, as by enclosing the air hermetically, the gas inside of the vessel is brought quickly to a high temperature, even with a very small discharge. It is difficult to estimate how much of the energy is lost in sound waves, audible or not, in a powerful discharge. When the currents through the gap are large, the electrodes may become rapidly heated, but this is not a reliable measure of the energy wasted in the arc, as the loss through the gap itself may be comparatively small. The air or a gas in general is, at ordinary pressures at least, clearly not the best medium through which a disruptive discharge should occur. Air or other gas under great pressure is of course a much more suitable medium for the discharge gap. I have carried on long-continued experiments in this direction, unfortunately less practicable on account of the difficulties and expense in getting air under great pressure. But even if the medium in the discharge space is solid or liquid, still the same losses take place, though they are generally smaller, for just as soon as the arc is established, the solid or liquid is volatilized. Indeed, there is no body known which would not be disintegrated by the arc, and it is an open question among scientific men, whether an arc discharge could occur at all in the air itself without the particles of the electrodes being torn off. When the current through the gap is very small and the arc very long, I believe that a relatively considerable amount of heat is taken up in the disintegration of the electrodes, which partially on this account may remain quite cold.

The ideal medium for a discharge gap should only *crack*, and the ideal electrode should be of some material which cannot be disintegrated. With small currents through the gap it is best to employ aluminum, but not when the currents are large. The disruptive break in the air, or more or less in any ordinary medium, is not of the nature of a crack, but it is rather comparable to the piercing of innumerable bullets through a mass offering great frictional resistance to the motion of the bullets, this involving considerable loss of energy. A medium which would merely crack when strained electrostatically—and this possibly might be the case with a perfect vacuum, that is, pure ether—would involve a very small loss in the gap, so small as to be entirely negligible, at least theoretically, because a crack may be produced by an infinitely small displacement. In exhausting an oblong bulb provided with two aluminum terminals with the greatest care I have succeeded in producing such a vacuum that the secondary discharge of a disruptive discharge coil would break through disruptively through the bulb in the form of fine spark streams. The curious point was that the discharge would completely ignore the terminals and start far behind the two aluminum plates which served as electrodes. This extraordinarily high vacuum could only be maintained for a very short while. To return to the ideal medium, think, for the sake of illustration, of a piece of glass or similar body clamped in a vice, and the latter lightened more and more. At a certain point a minute increase of the pressure will cause the glass to crack. The loss of energy involved in splitting the glass may be practically nothing, for though the force is great, the displacement need be but extremely small. Now imagine that the glass would possess the property of closing again perfectly the crack upon a minute diminution of the pressure. This is the way the dielectric in the discharge space should behave. But inasmuch as there would be always some loss in the gap the medium which should be continuous should exchange through the gap at a rapid rate. In the preceding example, the glass being perfectly closed, it would mean that the dielectric in the discharge space possesses a great insulating power; the glass being cracked, it would signify that the medium in the space is a good conductor. The dielectric should vary enormously in resistance by minute variations of the E. M. F. across the discharge space. This condition is attained but in an extremely imperfect manner, by warming the air space to a certain critical temperature, dependent on the E. M. F. across the gap, or by otherwise impairing the insulating power of the air. But as a matter of fact the air does never break down *disruptively*, if this term be rigorously interpreted, for before the sudden rush of the current occurs, there is always a weak current preceding it, which rises first gradually and then with comparative suddenness. That is the reason why the rate of change is very much greater when glass, for instance, is broken through, than when the break takes place through an air space of equivalent dielectric strength. As a medium for the discharge space a solid, or even a liquid would be preferable therefore. It is somewhat difficult to conceive of a solid body which would possess the property of closing instantly after it has been cracked. But a liquid, especially under great pressure, behaves practically like a solid, while it possesses the property of closing the crack. Hence it was thought that a liquid insulator might be more suitable as a dielectric than air. Following out this idea, a number of different forms of dischargers in which a variety of such insulators, sometimes under great pressure, were employed, have been experimented upon. It is thought sufficient to dwell in a few words upon one of the forms experimented upon. One of these dischargers is illustrated in Figs. 4*a* and 4*b*.

A hollow metal pulley P (Fig. 4*a*), was fastened upon an arbor *a*, which by suitable means was rotated at a considerable speed. In the inside of the pulley, but disconnected from the same, was supported a thin disc *h* (which is shown thick for the sake of clearness), of hard rubber, in which there were embedded two metal segments *s s* with metallic extensions *e e* into which were screwed conducting terminals *t t* covered with thick tubes of hard rubber *t t*. The rubber disc *h* with its metallic segments *s s*, was finished in a lathe, and its entire surface highly polished so as to offer the smallest possible frictional resistance to the motion through a fluid. In the hollow of the pulley an insulating liquid such as a thin oil was poured so as to reach very nearly to the opening left in the flange *f*, which was screwed tightly on the front side of the pulley. The terminals *t t*, were connected to the opposite coatings of a battery of condensers so that the discharge occurred through the liquid. When the pulley was rotated the liquid was forced against the rim of the pulley and considerable fluid pressure resulted. In this simple way the discharge gap was filled with a medium which behaved practically like a solid, which possessed the quality of closing instantly upon the occurrence of the break, and which moreover was circulating through the gap at a rapid rate. Very powerful effects were produced by dischargers of this kind with liquid interrupters, of which a number of different forms were made. It was found that, as expected, a longer spark for a given length of wire was obtainable in this way than by using air as an interrupting device. Generally the speed, and therefore also the fluid pressure, was limited by reason of the fluid friction, in the form of discharger described, but the practically obtainable speed was more than sufficient to produce a number of breaks suitable for the circuits ordinarily used. In some instances the metal pulley P was provided with a few projections inwardly, and a definite number of breaks was then produced which could be computed from the speed of rotation of the pulley. Experiments were also carried on with liquids of different insulating power with the view of reducing the loss in the arc. When an insulating liquid is moderately warmed the loss in the arc is diminished.



FIGS. 4*a* AND 4*b*.—FORM OF DISCHARGER WITH LIQUID INTERRUPTER.

A point of some importance was noted in experiments with various dischargers of this kind. It was found, for instance, that whereas the conditions maintained in these forms were favorable for the production of a great spark length, the current so obtained were not best suited to the production of light effects. Experience undoubtedly has shown, that for such purposes a harmonic rise and fall of the potential is preferable. Be it that a solid is rendered incandescent, or phosphorescent, or be it that energy is transmitted by condenser coating through the glass, it is quite certain that a harmonically rising and falling potential produces less destructive action, and that the vacuum is more permanently maintained. This would be easily explained if it were ascertained that the process going on in an exhausted vessel is of an electrolytic nature.

In the diagrammatical sketch, Fig. 1, which has been already referred to, the cases which are most likely to be met with in practice are illustrated. One has at his disposal either direct or alternating currents from a supply station. It is convenient for an experimenter in an isolated laboratory to employ a machine G such as illustrated, capable of giving both kinds of currents. In such case it is also preferable to use a machine with multiple circuits, as in many experiments it is useful and convenient to have at one's disposal currents of different phases. In the sketch, D represents the direct and A the alternating circuit. In each of these, three branch circuits are shown, all of which are provided with double line switches *s s s s s s*. Consider first the direct current conversion; I*a* represents the simplest case. If the E. M. F of the generator is sufficient to break through a small air space, at least when the latter is warmed or otherwise rendered poorly insulating, there is no difficulty in maintaining a vibration with fair economy by judicious adjustment of the capacity, self-induction and resistance of the circuit L containing the devices *l l m*. The magnet N, S, can be in this case advantageously combined with the air space. The discharger *d d* with the magnet may be placed either way, as indicated by the full or by the dotted lines. The circuit I*a* with the connections and devices is supposed to possess dimensions such as are suitable for the maintenance of a vibration. But usually the E. M. F on the circuit or branch I*a* will be something like 100 volts or so, and in this case it is not sufficient to break through the gap. Many different means may be used to remedy this by raising the E. M. F. across the gap. The simplest is probably to insert a large self-induction coil in series with the circuit L. When the arc is established, as by the discharger illustrated in Fig. 2, the magnet blows the arc out the instant it is formed. Now the extra current of the break, being of high E. M. F., breaks through the gap, and a path of low resistance for the dynamo current being again provided, there is a sudden rush of the current from the dynamo upon the weakening or subsidence of the extra current. This process is repeated in rapid succession, and in this manner I have maintained oscillation with as low as 50 volts, or even less, across the gap. But conversion on this plan is not to be recommended on account of the too heavy currents through the gap and consequent heating of the electrodes; besides, the frequencies obtained in this way are low, owing to the high self-induction necessarily associated with the circuit. It is very desirable to have the E. M. F. as high as possible, first, in order to increase the economy of the conversion, and, secondly, to obtain high frequencies. The difference of potential in this electric oscillation is, of course, the equivalent of the stretching force in the mechanical vibration of the spring. To obtain very rapid vibration in a circuit of some inertia a great stretching force or difference of potential is necessary. Incidentally, when the E. M. F. is very great, the condenser which is usually employed in connection with the circuit need have but a small capacity, and many other advantages are gained. With a view of raising the E. M. F. to a many times greater value than obtainable from ordinary distribution circuits, a rotating transformer *g* is used, as indicated at II*a*, Fig. 1, or else a separate high potential machine is driven by means of a motor operated from the generator G. The latter plan is in fact preferable, as changes are easier made. The connections from the high tension winding are quite similar to those in branch I*a* with the exception that a condenser C, which should be adjustable, is connected to the high tension circuit. Usually, also, an adjustable self-induction coil in series with the circuit has been employed in these experiments. When the tension of the currents is very high the magnet ordinarily used in connection with the discharger is of comparatively small value, as it is quite easy to adjust the dimensions of the circuit so that oscillation is maintained. The employment of a steady E. M. F. in the high frequency conversion affords some advantages over the employment of alternating E. M. F. as the adjustments are much simpler and the action can be easier controlled. But unfortunately one is limited by the obtainable potential difference. The windings also break down easily in consequence of the sparks which form between the sections of the armature or commutator when a vigorous oscillation takes place. Besides, these transformers are expensive to build. It has been found by experience that it is best to follow the plan illustrated at III*a*. In this arrangement a rotating transformer *g*, is employed to convert the low tension direct currents into low frequency alternating currents, preferably also of small tension. The tension of the currents is then raised in a stationary transformer T. The secondary S of this transformer is connected to an adjustable condenser C which discharges through the gap or discharger *d d*, placed in either of the ways indicated, through the primary P of a disruptive discharge coil, the high frequency currents being obtained from the secondary S of this coil, as described on previous occasions. This will undoubtedly be found the cheapest and most convenient way of converting direct currents.

The three branches of the circuit A represent the usual cases met in practice when alternating currents are converted. In Fig. I*b* a condenser C, generally of large capacity, is connected to the circuit L containing the devices *l l*, *m m*. The devices *m m* are supposed to be of high self-induction so as to bring the frequency of the circuit more or less to that of the dynamo. In this instance the discharger *d d* should best have a number of makes and breaks per second equal to twice the frequency of the dynamo. If not so, then it should have at least a number equal to a multiple or even fraction of the dynamo frequency. It should be observed, referring to I*b*, that the conversion to a high potential is also effected when the discharger *d d*, which is shown in the sketch, is omitted. But the effects which are produced by currents which rise instantly to high values, as in a disruptive discharge, are entirely different from those produced by dynamo currents which rise and fall harmonically. So, for instance, there might be in a given case a number of makes and breaks at *d d* equal to just twice the frequency of the dynamo, or in other words there may be the same number of fundamental oscillations as would be produced without the discharge gap, and there might even not be any quicker superimposed vibration; yet the differences of potential at the various points of the circuit, the impedance and other phenomena, dependent upon the rate of change, will bear no similarity in the two cases. Thus, when working with currents discharging disruptively, the element chiefly to be considered is not the frequency, as a student might be apt to believe, but the rate of change per unit of time. With low frequencies in a certain measure the same effects may be obtained as with high frequencies, provided the rate of change is sufficiently great. So if a low frequency current is raised to a potential of say 75,000 volts and the high tension current passed through a series of high resistance lamp filaments, the importance of the rarefied gas surrounding the filament is clearly noted, as will be seen later; or, if a low frequency current of several thousand amperes is passed through a metal bar, striking phenomena of impedance are observed, just as with currents of high frequencies. But it is, of course, evident that with low frequency currents it is impossible to obtain such rates of change per unit of time as with high frequencies, hence the effects produced by the latter are much more prominent. It was deemed advisable to make the preceding remarks, inasmuch as many more recently described effects have been unwittingly identified with high frequencies. Frequency alone in reality does not mean anything, except when an undisturbed harmonic oscillation is considered.

In the branch III*b* a similar disposition as in I*b* is illustrated, with the difference that the currents discharging through the gap *d d* are used to induce currents in the secondary S of a transformer T. In such case the secondary should be provided with an adjustable condenser for the purpose of tuning it to the primary.

II*b* illustrates a plan of alternate current high frequency conversion which is most frequently used and which is found to be most convenient. This plan has been dwelt upon in detail on previous occasions and need not be described here.

Some of these results were obtained by the use of a high frequency alternator. A description of such machines will be found in my original paper before the American Institute of Electrical Engineers, and in periodicals of that period, notably in THE ELECTRICAL ENGINEER of March 18, 1891.

I will now proceed with the experiments.

THE ELECTRIC LIGHT ASSOCIATION OF JAPAN.

MR. GEORGE F. PORTER, secretary of the National Electric Light Association, has received the following letter from Mr. Fujioka of Tokio, Japan, who is well known to many American electricians. He visited this country in 1884:

TOKYO, JAPAN, April 17th, 1893.

NATIONAL ELECTRIC LIGHT ASSOCIATION,
New York.

Dear Sir:—

I have received a copy of the Proceedings of the Fifteenth Convention which you kindly sent me, and for which I thank you very much.

I may state that last year we organized a society something after your association, called the Electric Light Association of Japan, of which I am the president at present. I have now the pleasure of sending you two copies of Proceedings for the First and Second Conventions, which though entirely written in Japanese language, will, I hope, interest you to some extent. You will find in the Proceedings of the Second Convention, my humble portrait and plan of 5 electric light stations belonging to the Tokyo Electric Light Company. There are at present 20 Central Stations in Japan—8 in Tokyo, 2 in Osaka, 1 in Kobe, 2 in Kyoto, 1 in Nagoya, 2 in Yokohama, 1 in Nagasaki, 1 in Kumamoto, 1 in Yumoto, Hakone, 1 in Sapporo, Hokkaido, and a number of stations are now being erected.

Yours faithfully,
I. FUJIOKA.

The pamphlets are most interesting and full of information, our Japanese editor says. They illustrate diagrammatically the methods adopted, in laying out central stations in Japan, with all the machinery preferably on one floor as a precaution against earthquakes.

SOCIETY AND CLUB NOTES.

PRELIMINARY PROGRAMME OF THE INTERNATIONAL ELECTRICAL CONGRESS.

WE have received a copy of the preliminary programme prepared for the Chicago Electrical Congress by the Advisory Council Committee on Programme. Its contents are given below. As is already understood, the "General Congress" will include a smaller body to be known as the "Chamber of Delegates," which will consist of those specially designated as representative delegates from the various governments, appointed for the purpose of considering electric units and their values and making recommendations as to the legalization of the same. We have already (E. E., May 24) given the names of the American and English delegates to the upper chamber.

The opening session of the General Congress will be held Monday, August 21, at 3 o'clock p. m., when the following order of business will be gone through:—1. The Congress will be called to order by the Chairman of the Advisory Council, Dr. Elisha Gray, of Highland Park, Ill. 2. Election of temporary chairman and secretary. 3. Appointment of a committee to nominate permanent officers. The officers will consist of a president; a vice-president for each nation sending delegates to the Chamber; a secretary. 4. Report of this committee. 5. Short addresses by the president, and by a few of the vice-presidents. 6. Announcements and adjournment.

At the close of this meeting the Chamber of Delegates will assemble for preliminary organization, which will proceed as follows:—1. The Chamber will be called to order by one of the delegates representing the United States. 2. Election of a temporary secretary. 3. Appointment of a committee of five on credentials. 4. Fixing a time for regular sessions. Adjournment. At the next meeting of the Chamber the committee on credentials will report, and a permanent organization will be completed.

DIVISION INTO SECTIONS.

The general congress will be divided into three sections, as follows:

A—The section of pure theory, including electric waves, theories of electrolysis, electric conduction, magnetism, etc. B—The section of theory and practice, including studies of dynamos, motors, storage batteries, measuring instruments, materials for standards, etc. C—The section of pure practice, including telegraphy and telephony, electric signaling, electric traction, transmission of power, systems of illumination, etc.

These sections will meet for organization and work at 10 a. m., August 22. Their organization will consist of the election of a chairman, a vice-chairman, a secretary and a sectional committee of three in addition to the officers named above. Temporary presiding officers will be as follows:—Section A—Prof. H. A. Rowland. Section B—Prof. Charles R. Cross. Section C—Prof. A. Graham Bell.

Sections will meet at 10 o'clock a. m., on Tuesday, Wednesday, Thursday and Friday, continuing in session at will, except on Friday, when they will finally adjourn as sections not later than 1 o'clock, p. m. Each section will have authority to divide into subsections if it is thought to be desirable.

Papers are solicited upon the following subjects, or upon other topics which may be considered suitable in character. They should be sent to the chairman of the programme committee, not later than August 1, 1893. Such as are accepted by that committee, will be put upon the programme of the congress, to be presented in full or by abstract according to the time available:—

Magnetic units and modes of embodying them in concrete standards; methods of avoiding electrical interference and risks to person and property; national and municipal testing laboratories; materials for standards of electric resistance; points of difference of the electrical vocabulary used in different countries; the direct conversion of the energy of fuel into electric energy; comparison of the various methods employed for the electric transmission of power; the cost of insulation in relation to high pressure for the electric transmission of power; comparison of the economies of the various systems of electric distribution; alternate currents motors; the behavior of transformers when supplying power to alternate current motors; the construction of condensers for alternate current purposes; the measurement of power in polyphase currents; direct-coupled and non-direct-coupled dynamos; the use of equalizing dynamos in a three and five-wire system; the use of accumulators in central stations; the proportions between output of dynamos and the weight of copper and iron employed in their construction; electric traction; application of electric power in mining; the adoption of a uniform method of distinguishing positive and negative mains; electric supply meters, American, British, Continental; criterion of sensibility of galvanometers; commercial instruments for measurement of electric quantities; the relation between the voltage of the arc and the quality and composition of the carbons; the aging of glow lamps; the electric working of metals; the use of electric and magnetic tests for ascertaining the mechanical properties of metals and alloys; the best material and mode of erection of lightning conductors in the light of recent researches in electric discharges the prospecting for iron by magnetic surveys; international telegraphy; fast-speed and long-distance telegraphy; the use of batteries or other generators for telegraphy; telegraphic lines—land and sea; harmonic telegraphy; writing telegraphs; long distance telephony; the possibility of providing telephonic communication without wires; application of electric signaling to the working of railways (alarms, time, etc.), and to naval and military purposes; magnetic separators; the use of electricity in engraving and in art reproductions.

The time allotted to the discussion of the papers presented will be determined by the several sectional committees. In the discussion of papers the chairman of the section will name the first speaker.

THE CHAMBER OF DELEGATES.

The following topics will be considered by the Chamber of Delegates:

Adoption of definitions and values of fundamental units of resistance, current and E. M. F.; adoption of definitions and values of magnetic units; adoption of definition and value of the unit of self-induction; definitions and values of light, energy and other units; the standardization of electric lights; the consideration of an International System of Notation and Conventional symbols and of a more uniform and accurate use of terms and phrases in electrical literature; a commercial standard of copper resistance.

Together with such other topics as may properly come before this body.

The hours of meeting for the Chamber of Delegates shall be determined, after the first session, by the Chamber itself; and it shall also decide upon the admission of persons not delegates to its sittings.

It shall finally adjourn not later than 1 o'clock, p. m., on Friday, August 25, and at the last meeting of the General Congress, the officers of the Chamber shall report to it a summary of its proceedings and the conclusions reached.

Public lectures of a popular character will be delivered by eminent electricians at 8 o'clock p. m., on Tuesday, Thursday and Friday of the Congress week.

The General Congress will assemble to hear reports and for final adjournment at 3 o'clock p. m., Friday, August 25.

This programme report is signed by the committee on programme:

Prof. T. C. Mendenhall, Washington, D. C., chairman; Carl Hering, Philadelphia, Pa.; Prof. W. A. Anthony, Manchester, Conn.; Prof. H. A. Rowland, Baltimore, Md.; A. E. Kennelly, Orange, N. J.; Prof. F. B. Crocker, New York City; Prof. E. L. Nichols, Ithaca, N. Y.; Prof. H. S. Carhart, Ann Arbor, Mich.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE following gentlemen were elected to associate membership in the Institute at the council meeting held on May 16:

Fred. Fiske Barbour, Manager, Power and Mining Department, Pacific District, General Electric Company, 15 First street, San Francisco, Cal.; A. Barth-Bartoshevitch, Mechanical and Electrical Engineer, Westinghouse Electric and Manufacturing Company, 160 Arch street, Allegheny City, Pa.; C. Waldo Bryant, Manager and Treasurer, the Bryant Electric Company, Bridgeport, Conn.; James Burke, Electrical Engineer, General Electric Company, 24 Front street, Schenectady, N. Y.; John Alfred Cabot, city electrician, 123 Garfield Place, Cincinnati, O.; Adolph Frederick Christmas, Manager, Electrical Department, Johnson Company, Johnstown, Pa.; J. Hally Craig, Cumner Craig & Co., John Hancock Building, Boston, Mass.; Manuel Ignacio da Cunha, Manager of the Electrical Section, Empreza Industrial Gran-Para, Para, United States of Brazil; Thomas B. Doolittle, Engineering Department, American Bell Telephone Company, 125 Milk street, Boston, Mass.; Henry W. Frye, Associate Editor, The *Electrical World*, *Times*' Building, New York City; Clarence E. Gifford, Assistant Electrical Engineer, the Buffalo Railway Company, 860 Prospect avenue, Buffalo, N. Y.; George Heli Guy, Secretary, the New York Electrical Society, 131 West Thirty-fourth street, New York City; Charles A. Lieb, General Electric Company, 44 Broad street, New York City; James Grieve Lorrain, Norfolk House, Norfolk street, London, W. C., England; Charles P. Matthews, Instructor in Physics, Cornell University, 15 Heustis street, Ithaca, N. Y.; Theodore J. W. Olan, Civil and Electrical Engineer, New York City; Walter M. Petty, W. M. Petty & Co., General Electrical Supplies, Rutherford, N. J., and New York City; Fred. A. Scheffler, Agent, Stirling Boiler Company, 74 Cortlandt street, New York City; George C. Sonn, Instructor in Physics, Newark High School, 285 Bellevue avenue, Newark, N. J.; Alfred E. Wiener, Electrical and Mechanical Engineer, General Electric Company, 24 Yates street, Schenectady, N. Y.; Peter Wright, Inspector of Electrical Works, United Gas Improvement Company, C. Drexel Building, Philadelphia, Pa.; V. H. Yarnall, Superintendent of Construction, J. G. White Company, New York City.

ELECTRIC HEATING AT THE CHICAGO ELECTRIC CLUB.

The very interesting meeting arranged for last week at the Chicago Electric Club, on the subject of electric heating, failed to attract as large an attendance as might have been expected, there being barely half a dozen members present. Three papers were ready, which were taken as read. One was by S. B. Jenkins, of Boston; one by T. Ahearn, of Ottawa; and one by Carl K. McFadden, of Chicago. We hope to present an abstract of these in an early issue.

ELECTRIC COOKING AT THE ST. LOUIS ELECTRIC CLUB.

Last night was "experimental night" at the rooms of the Electric Club, says the St. Louis *Globe-Democrat*, and a large number of the members, accompanied by ladies, were present to witness the cooking of a meal with electricity as the heating power. The majority of the utensils used are patterned after the ordinary kinds, excepting that at the bottom is placed a square or oblong piece of polished or plated iron or steel large enough to cover the bottom, so that it will set even. It is to this arrangement at the bottom that the current is attached by means of the ordinary insulated wire, and through which it passes and accumulates a heat that does not require work which is now being done by coal or other kinds of fuel. The ovens used for baking meats, bread, etc., are similar to the gasoline or gas stove oven, but are more compact, and do not throw out nearly the same heat. In fact, a pot of flowers was placed without the slightest damage, on one of the ovens used last night, in which a 15 pound turkey was baked to perfection. The exhibition given last night was the first of the kind ever given in the city, and meats, bread, griddle cakes, potatoes, coffee, and other dishes were prepared and were highly complimented by the ladies.

THE NEW YORK ELECTRICAL SOCIETY.

The lecture delivered by Dr. Wm. J. Morton before this Society and abstracted in last week's issue, brings to a close a most successful year. The papers read have included topics of a most practical and instructive nature, and the society's growing influence is shown by the large increase in its membership during the year just closed.

At the last meeting an invitation was received by the society to attend the performance of "The Seven Ages of Man," at the Urania Theatre, 100 tickets having been placed at the disposal of the society by Mr. Leon Margulies, assistant manager, and Mr. J. C. Mayrhofer, electrician in charge. The performance took place on Friday, May 19, and was much enjoyed by the members.

After the performance the members were invited behind the scenes, where Mr. Mayrhofer explained the electrical apparatus and put in operation the methods employed for obtaining the remarkable scenic effects.

REPORTS OF COMPANIES.

GENERAL ELECTRIC SALE OF EDISON LOCAL STOCKS.

There was a renewal of depression in General Electric stock last week, due to the sale by the company of large blocks of its Boston and New York Edison stocks, secured in return for license, etc. Under the reports of these sales, the quotations of General Electric went last Thursday as low as $69\frac{7}{8}$, over 40,000 shares being dealt in. On Friday it closed at $70\frac{5}{8}$. The company is said to have sold 4,000 Boston Edison at a price rising $125 per share and 15,000 shares of New York Edison at prices rising a little above par. These two sales would give it $2,000,000 cash and enable it to meet its more pressing current liabilities. Kuhn & Loeb are said to have been the principal purchasers, on European account. Both local companies are doing an excellent business, and the prices at which the stock has been sold are not high. The officers of the General Electric Co. consider the transaction a good one, and state that the company has not sold the stocks from any urgent need of money. Their announcement on the subject issued last Friday says that the company has realized that a determined attack is being made apparently on its credit, and to place itself therefore on a basis financially beyond the possibilities of harm, it has adopted the policy of increasing its cash resources by the sale of such portion of the securities of local companies now in its treasury as can be easily and profitably made. It has in its treasury about $7,000,000 of good securities, and negotiations are in progress for the sale of many of them at prices above inventory value. During 1892 the company sold more than $5,000,000 of such securities, and, it is explained, the acquisition and sale of royalty and other bonds and securities has always formed a secure and profitable part of its business. The company has on hand $1,500,000 in cash in addition to the proceeds of the sale just made. Its outstanding debts are comparatively small, the amount coming due in the next sixty days being less than $500,000. The entire outstanding obligations of the company, including long-time paper, which cannot be disturbed until maturity, are but slightly in excess of the cash on hand, plus the amount to be received from the various securities recently negotiated. The cash now being accumulated will be used to cancel these liabilities as they mature.

NATIONAL ELECTRIC MANUFACTURING CO.

The affairs of the above company of Eau Claire, Wis., have been placed in the hands of Ralph E. Rust, as receiver. There will be no interruption of the business. The plant is said to be worth $300,000. The assets are about $560,000, and the liabilities about $375,000.

The Archer & Pancoast Manufacturing Co., of 900 Broadway, the leading gas and electric fixture manufacturers, have been unable to meet their maturing notes, and have gone into the hands of receivers, with obligations of $1,000,000. The receivers are A. V. Pancoast and A. T. Enos. It is expected that the firm's liabilities will be fully met.

LEGAL NOTES.

THE PATENT OFFICE SCANDAL.

Messrs. Simonds, Bennett, Foster and Freeman have filed their answers to the petition for their disbarment from Patent Office practice for alleged irregularities in supplying and buying secret documents. They deny any impropriety.

BELL TELEPHONE LITIGATION.

The application at McKeesport for an injunction under the Bell telephone patent came up last week, but the case was adjourned until Monday, May 29.

PERSONAL.

A VACANCY AT JOHNS HOPKINS.

Mr. Francis Head, M. E., instructor in mechanics of engineering, machine design and mechanical drawing in the Electrical Engineering Department of the Johns Hopkins University, has resigned to go into practical work. We understand no one has yet been appointed to take his place.

Prof. D. C. Jackson, of the electrical engineering department of the University of Wisconsin, has an interesting article in the issue of the University *Aegis*, of May 5, on "The Position of Engineering Courses in Colleges." It is an admirable, though brief, discussion of the subject, and emphasizes the high value and importance of the engineering studies.

Mr. A. E. Childs.—The engagement is accounced of Mr. Arthur E. Childs, engineer and agent at Philadelphia, of the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., to Miss Alice G. Moen, daughter of the late Mr. Philip L. Moen, of the Washburn & Moen Manufacturing Company, of Worcester, Mass.

THE NEW ELECTRIC RAILWAY LAW IN CONNECTICUT.

A special dispatch from Hartford of May 20 says: The important piece of legislation of the week was the passage of the compromise bill on the electric roads systems. This bill has been steadily fought by the steam-road interests and greatly hampered by clauses which would prevent it being of any real value to the development of new lines of communication, but the House did not agree with the Senate on the bill, and a compromise brought forth a measure much more moderate than that passed by the Senate. Paralleling of steam roads is permitted when shown to be of necessity before the courts; likewise the freight clause is so worded that the courts have jurisdiction. This bill makes it possible for the individual charters to be granted rapidly, as there will be no fight between them and the old-line railroads.

CAMBRIDGE STORAGE BATTERY COMPANY DEFEATED.

Some time ago the Cambridge Storage Battery Company applied to the Massachusetts Legislature for permission to run storage battery cars on the tracks of the West End Street Railway of Boston. The cars were to be the same as those in use on the Milford and Hopedale railway. The bill passed the house all right, but last week the Senate, after visiting Milford to inspect the working of the cars, defeated the bill by a majority of 30 to 5.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED MAY 23, 1893.

Accumulators :—

Electric Accumulator, P. J. R. Dujardin, Paris, France, 497,869. Filed March 15, 1892.

Claim follows :

The process herein described of forming accumulator plates, consisting in decomposing a proportion of alkaline nitrate by an electric current in an acidulated bath, whereby the reactions indicated are caused and producing on the plates an adhering layer of peroxide of lead.

Alarms and Signals :—

Thermostat, E. C. C. Krogh, Monmouth, Ill., 497,800. Filed Jan. 11, 1893

An open circuit thermostat.

Thermostatic Instrument, M. Martin, Malden, Mass. 497,923. Filed Aug. 9, 1892.

Especially adapted to operate at relatively low temperatures.

District-Telegraph Return-Signal Key, J. M. Bell, Tacoma, Wash., 497,942. Filed Oct. 24, 1892.

Thermal Circuit-Closer and Indicator, J. L. Bradley, St. Louis, Mo., 498,183. Filed Dec. 5, 1892.

Designed to signal the exact floor of a building where fire exists.

Conductors, Conduits and Insulators :—

Insulation for Underground Wires, P. Wright, Denver, Colo., 497,852. Filed Aug. 18, 1892.

Claim 1 follows :—

An electrical conductor inclosed in a tube hermetically sealed at both ends, and surrounded at intervals by divided insulating washers or thimbles, having substantially the same diameter as the inner diameter of the tube.

Distribution :—

Safety Appliance for Systems of Electric Distribution, E. Thomson, Lynn, Mass., 497,888. Filed Jan. 29, 1890.

Especially adapted to alternating current transformer systems. A ground connection is taken from a part of the secondary circuit liable to receive a high tension current from the main or primary (although insulated) and means are provided for establishing a low resistance ground from the local circuit by the action of a high tension escape from the main.

Dynamos and Motors :—

Armature for Electric Motors or Generators, J. F. McLaughlin, Philadelphhia, Pa., 497,887. Filed Dec. 17, 1892.

Improvement upon the armature patented to the same inventor Sept. 1, 1891, 458,856. Enables a single section of winding to be removed for repairs without dismantling the entire armature.

Electric Motor or Generator, J. F. McLaughlin, Philadelphia, Pa., 497,888. Filed July 27, 1892.

Details of construction of armature.

Heating :—

Electric Heater, S. M. Cook, Boston, Mass., 497,771. Filed Jan. 17, 1893.

Adapted for cooking. Employs reverse windings to obviate magnetization of iron parts.

Electric Broiler, S. B. Jenkins, Boston, Mass., 497,790. Filed October 14, 1892.

A grid-iron. Employs tubular transverse bars enclosing magnetizable rods wound with insulated wire.

Electric Radiator, S. B. Jenkins, Boston, Mass., 497,791. Filed Nov. 25, 1892.

For heating rooms.

Electric Flat Iron Heater, S. B. Jenkins, Boston, Mass., 497,792. Filed Dec. 5, 1892.

Employs alternate balls or blocks of graphite, or equivalent material, and conducting plates.

Electric Soldering Iron, S. B. Jenkins, Boston, Mass., 497,793. Filed Dec. 5, 1892.

Has within the body of the soldering iron a pile of discs or plates of semi-conducting material, and is adapted to concentrate heat at the point of the iron.

Electric Heater for Flat Irons or Other Articles, S. B. Jenkins, Boston, Mass., 497,794. Filed Dec. 5, 1892.

Employs a series of alternate metallic and non-metallic elements.

Electric Heater, S. B. Jenkins, Boston, Mass., 497,795. Filed Dec. 8, 1892.

Similar to the next above.

Method of Manufacturing Electric Heaters, H. G. O'Neill, Boston, Mass., 468,078. Filed Aug. 20, 1892.

Claim follows:

The method of forming electrical heaters, which consists in moulding a carbonizable filament inside a heater body composed of plastic material, and in subsequently heating the body and filament to bake the former and carbonize the latter.

Lamps and Appurtenances :—

Wall Socket for Incandescent Lamps, H. C. Wirt, Boston, Mass., 497,849. Filed March 7, 1892.

Electrode-Shield for Arc Lamps, C. E. Scribner, Chicago, Ill., 497,898. Filed Nov. 8, 1890.

Especially adapted to focusing lamps. The shield surrounding the lower portion of the upper carbon is supported by a device suspended upon the lower carbon, by which the shield is made to follow the arc.

Temporary Circuit Connector for Incandescent Electric Lamps, G. A. Frei, Springfield, Mass., 497,955. Filed Dec. 19, 1892.

Adapted for use in the operation of renewing burned-out lamps.

Incandescent Lamp, G. A. Frei, Springfield, Mass., 497,956. Filed Dec. 19, 1892.

To prevent the opening of a circuit when the carbon filament of a lamp gives out.

Incandescent Electric Lamp, G. A. Frei, Springfield, Mass., 497,657. Filed Feb. 7, 1893.

Relates to the filament support.

Electrode for Arc Lamps, A. C. Siebold, Mount Vernon, N. Y., 498,141. Filed Feb. 23, 1893.

Carbon is provided with two metallic coatings and an intermediate coating of non-metallic refractory material.

Incandescent-Electric-Lamp Socket, I. Goldkind, New York, N. Y., Reissue 11,341. Filed Nov. 22, 1892.

A socket adapted to be operated by a chain or cord when situated inconveniently high for direct manipulation.

Measurement :—

Electric Current Time-Meter, H. H. Pattee, Monmouth, Ill., 498,021. Filed Sept. 6, 1890.

A clock-work electro-mechanical meter adapted to measure and record the time during which current passes.

Electric Current Time-Meter, H. H. Pattee, Monmouth, Ill., 498,022. Filed Sept. 6, 1890.

Similar to the next above.

Medical and Surgical :—

Electrotherapeutic Apparatus, H. C. Royer, Los Angeles, Cal., 497,822. Filed Oct. 8, 1892.

An electric shoe.

Miscellaneous :—

Electrical Fuse-Link, H. C. Walls, Plymouth, Ind., 497,834. Filed March 2, 1893.

A method of joining fuse-wires to copper terminals.

Electric Steering-Gear, F. L. & L. H. Dyer, Washington, D. C., 498,160. Filed April 18, 1891.

Employs electro-mechanical devices, including an electric motor, to control the steering apparatus.

Torpedo, S. E. Mower & G. E. Haight, New Haven, Conn., 498,183. Filed July 5, 1892.

A self-propelling torpedo of high speed adapted to overtake a moving vessel and to penetrate any usual form of protective net.

Electric Mining Machine, F. A. Sperry, Chicago, Ill., 497,832. Filed Oct. 8, 1888.

A mining pick, employing an electric motor and a power-storing device—as a spring receiving and accumulating tension and discharging at intervals.

Combined Nut-Lock and Electrical Connection for Railroad-Rails, A. L. Johnson, Cleveland, O., 497,968. Filed April 27, 1892.

Railways and Appliances :—

Railroad Rail and Process of Uniting Same, A. J. Moxham, Johnstown, Pa., 497,808. Filed April 27, 1892.

Method of electrically welding rails or similar bodies. The ends to be joined are so shaped as at first to touch only at the central portion.

Safety Block System for Railway Signaling, W. R. Sykes, Jr., and J. P. O'Donnell, London, Eng., 497,836. Filed Oct. 1, 1892.

Details of circuits and electro-mechanical apparatus.

Electric Railway Trolley, E. H. Allen, Cramer Hill, N. J., 489,046. Filed Nov. 16, 1892.

Relates to the construction of the trolley and its bearings.

Conduit Electric Railway, H. F. Moffett, Portland, Ore., 498,135. Filed Oct. 7, 1892.

Claim 1 follows :

In an electric railway, the combination with the conduit and the track rails, of sleepers arranged on opposite sides of the conduit and supporting the rails, curved tie-bars extending beneath the conduit and secured to the sleepers and braces secured to the sleepers, tie-cars, and conduit.

Electric Railway Conduit, A. H. Hieatzman, Baltimore, Md., 498,169. Filed July 28, 1891.

Constructs a conduit entirely between the inner rails of a double-track railway. Designed to obviate the need of taking up existing tracks.

Electric Railway Conduit, J. L. Reynolds, Winterset, Ia., 498,169. Filed July 28, 1892.

Employs a self-closing slot, opening for the passage of the trolley bar and closing behind it.

THE WATTSON AND STEWART BLOCK SIGNAL SYSTEM.

On May 28 a test was made of a new block signal system placed in the New York, West Shore and Buffalo Railway Tunnel at Weehawken, N. J. The system is the joint invention of Mr. W. G. Wattson, division superintendent, and Mr. Jos. B. Stewart, superintendent of telegraph and signals of the road.

The main features of the system consist in the employment of electric lamps placed along the track about on a line with the eye of the engineer as close together as desirable (in the Weehawken tunnel they are placed about 300 feet apart). The lamps are normally lighted, which condition indicates safety and a clear track. The basic principle of operation is, "*Proceed*, when the lamps are lighted." "*Stop*, when the lamps are out." Lamps burning, "Safety. Go ahead." Lamps out, "Danger. Stop."

While this system is applicable to any part of a railroad system, the automatic device, which has been successfully tested, is especially adapted for the quick movement of trains through tunnels under conditions of absolute safety. By its use the capacity of a tunnel 3,000 feet long, or longer, can be doubled, or still further increased in proportion to its length. The Weehawken tunnel is 4,200 feet long, and the lamps have been placed so as to divide it in two sections, thus doubling its capacity for the movement of traffic as compared with the old system of a block office at either end and allowing but one train in the tunnel at a time going in one direction.

A train entering the tunnel at the east portal puts out all the lamps outside of the tunnel; the lamps are strung for 500 feet outside, and for 300 feet inside; also every alternate lamp for 900 feet further in the tunnel. The overlap lamps which alternate with the lamps in the first section, are left lighted for the train to run on to a point 2,300 feet inside, where the lamps in the second, or middle section are put out, thus producing a dark or shadow section of 1,100 feet immediately behind the train, which is maintained until the train passes out of the tunnel at the west end. At the same instant that the lamps in the second, or middle section are put out, those in the first section of 1,200 feet are lighted, so that when the train has reached a point 2,300 feet in the tunnel, the signal to proceed is displayed at the east end of the tunnel for a following train. When the train passes out of the tunnel at the west end, the lamps in the middle section are lighted

This is all done automatically by the train passing over an electrically connected track circuit, all the parts of which are very simple and can be understood and maintained by any ordinary lineman. The system is so arranged at Weehawken that the electric light circuits pass through the signal-tower, where the old semaphores are worked from, and a lamp connected with each circuit in the tunnel is displayed, so that the operator can tell at a glance the whereabouts of a train in the tunnel. By opening a small switch he can put out the lamps in any section and stop any train; or, he can put out all the lamps and stop all trains.

This system not only doubles the capacity of a tunnel and provides for the control of trains anywhere in it, but gives to the engineer, conductor and trainmen a *constantly* visual signal for the movement of the train. It will not be necessary for the engineer to reduce speed when approaching the end of a block section, expecting there to find the signal against him, as the dark section of 1,200 feet, or more, gives ample space to stop.

Under the present system of blocking, with one signal at the ends of the block sections, an engineer is liable to overlook or mistake the signal, especially when smoke or fog is thick and there is no way provided to stop the train after it passes the home signal; but, as stated before, with the new system the signal to stop can be given at any time by the operator cutting off the current from the lamps.

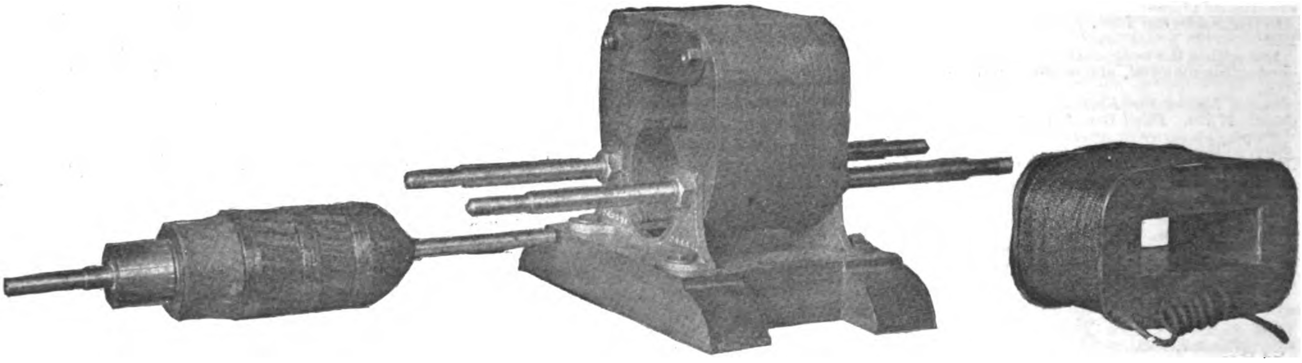
The instrument used to automatically cut off the electric light current can be worked with three cells of gravity battery and does its work without any sparking. The whole is so arranged that if any part is broken or disconnected, the danger-signal is displayed.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW PERRET MOTOR.

AMONG the first, if not the very first, to adopt laminated field magnets in the construction of their motors was the Elektron Manufacturing Company, of Springfield, Mass., and they have ever since adhered to this type of construction. Heretofore their two pole machines of small powers have been designed and built with consequent poles, which necessitated the employment of four magnet coils. In order to simplify the method of construction and still further to increase the efficiency, the company have recently brought out the design illustrated in the accompanying engraving, Fig. 1. The method of construction is well shown in Fig. 2, 3 and 4. Here, it will be noted, the fields are energized by a single coil. In order to enable the latter to be slipped on, the field is built up in two sections, but the joint is so thoroughly dovetailed that, magnetically considered, it is practically equivalent to a continuous mass of iron.



FIGS. 2, 3 AND 4.—THE NEW PERRET BIPOLAR MOTOR.

The excellent mechanical details which have always formed a prominent feature of the Elektron motors are retained and also improved upon in the new type; the bearings are of composition bronze and self-oiling, and carbon brushes are used for the usual low voltage circuits.

The type of motor illustrated is now being built in five sizes ranging from ¼ to 2 h. p.

NEW INTERIOR CONDUIT CATALOGUES.

THE INTERIOR CONDUIT & INSULATION COMPANY, of 44 Broad street, has just issued two new catalogues, from the Bartlett & Co. press. They are both handsome publications. The larger one is Catalogue No. 10, and is devoted to the regular conduit materials, switches, boxes, accessories; as well as power motors, etc. The smaller pamphlet treats only of the Lundell fan motors made by the Interior Company, and illustrates them in great detail, all the parts being carefully shown.

ANSONIA ELECTRIC COMPANY.

THOSE station managers who realize the value of standardized fuse wire, may be interested to know that the Wirt fuse wire handled by the Ansonia Electric Company, formerly the Electrical Supply Company, is standardized wire. The large sales which the Ansonia Electric Company, formerly the Electrical Supply Company, are making of Shield Brand wire, Stanley transformers and Helios lamps would tend to prove that it is a combination which operators of plants think very highly of.

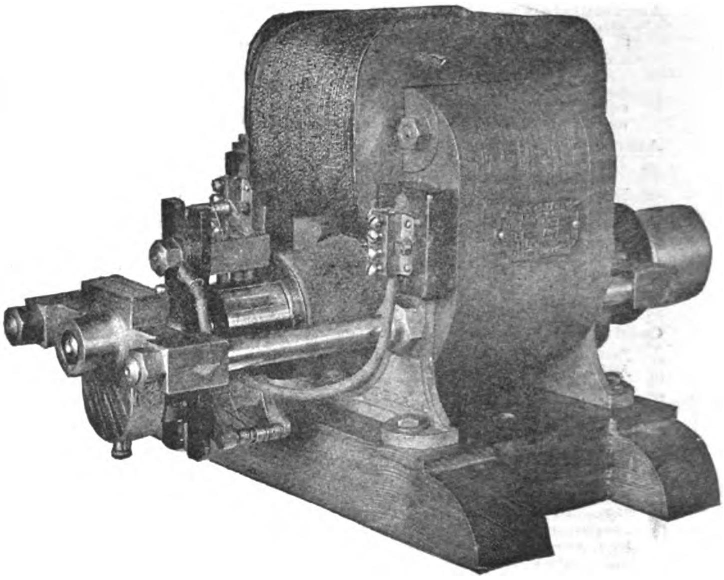


FIG. 1.—THE NEW PERRET BIPOLAR MOTOR.

A very neat little pamphlet has recently been issued by the Ansonia Electric Company, descriptive of the "W-W" lightning arrester, which ought to be of interest to every station superintendent or manager.

ARMINGTON & SIMS ENGINE COMPANY.

A VERY tasteful and interesting catalogue has just been issued by the Armington & Sims EngineCompany, bearing dateof April, 1893, and numbered XVIII. It is devoted to a description of their celebrated high-speed engines, and is copiously illustrated not only with choice engravings of the engines as a whole and in detail, but with several cards indicative of some very fine permormances. As a frontispiece there is a rich etching of the historic Edison "Jumbo" run by an Armington & Sims engine in 1881, and now on exhibition at the World's Fair, as described in the May 10 issue of THE ELECTRICAL ENGINEER. The company are to be congratulated on their long record of successfulwork, and on the evidence given in this catalogue that they are still in the vanguard of engine improvement and development.

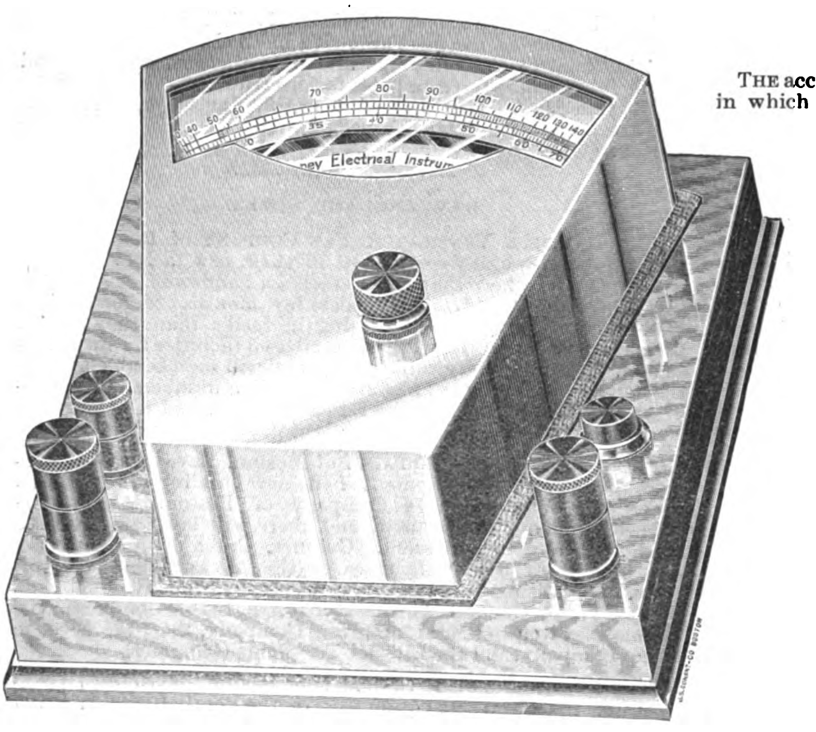
MR. ROBERT D. FRAZIER, who for some years has occupied a prominent position in the U. S. Patent Office, has accepted the appointment of Washington manager for Messrs. Howson & Howson, counselors-at-law and solicitors of patents; Mr. Frazier's headquarters at Washington are at 918 F street, and both he and Messrs. Howson & Howson are to be sincerely congratulated. Mr. Frazier is a graduate of the U. S. Naval Academy, class of '83.

THE NEW WHITNEY ALTERNATING CURRENT INSTRUMENTS.

The Electric Appliance Company, of Chicago, are at present flying flags at full mast over the success of the new Whitney instruments for alternating work. The alternating current voltmeter is a beautiful instrument with an almost uniformly divided scale, guaranteed absolutely accurate for the most careful measurements on any alternating current, being unaffected by variations in frequency. This has always been the great difficulty to overcome and in fact has, it is claimed, not heretofore been surmounted in alternating instruments, which has made it necessary to recalibrate each instrument for the particular machine on which it was to be used, whereas the Whitney instruments can be used on any kind of an alternating current or machine without in the least affecting its reading.

The uniform divisions of the scale is another point to which particular attention is called. Improvements in this respect are being continually made and the voltmeter scales as now divided are even more uniform than that shown in the accompanying cut. The 0 to 75 scales read from 15 to 20 in one volt divisions and from 20 to 75 in half volt divisions. The 0 to 150 scales read from 30 to 40 in two volt divisions and from 40 to 150 in one volt divisions. The double scale instrument combines both of the above scales and reads in the same way.

In the production of a perfect ammeter the Whitney Company say that they have achieved a very marked triumph. Heretofore it has been almost impossible to make any accurate quantity measurement of the alternating current without the use of a dynamometer requiring elaborate laboratory manipulation and considerable mathematical computation and it has up to the present been the aim of instrument makers to produce a portable or accurate alternating ammeter. The Whitney Company, have, they say, solved the problem and are now supplying their agents and the trade and securing splendid results with an alternating ammeter guaranteed absolutely accurate and satisfactorily readable as low as one-twentieth of an ampere in the small sizes with correspondingly small divisions for the larger capacities.



New Whitney Aternating Current Voltmeter.

In addition to having all of the above meritorious features, the Whitney instruments are low in price, which particularly recommends them to the trade; and the Electric Appliance Company who are general Western agents for all of the Whitney products are enjoying a splendid trade.

BALL ENGINES IN ELECTRIC LIGHT PLANTS.

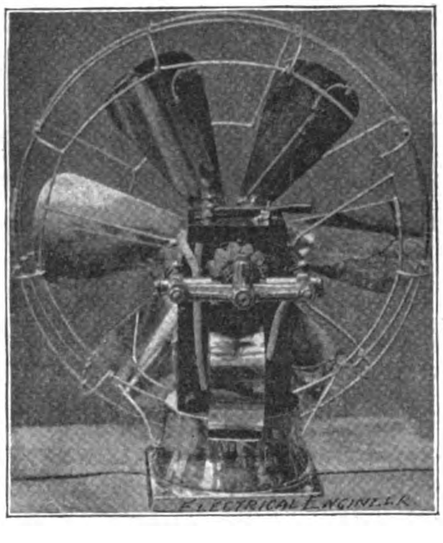
The Compania Mexicana Del Gas y Luz Electrica, have purchased a 100 h. p. cross compound engine and other material from the Ball Engine Company. The Fond du Lac Light, Power & Railway Company, Fond du Lac, Wis., have placed an order for three 100 h. p. tandem compound condensing engines with the Ball Engine Company, and the Intermountain Electric Company, Salt Lake City, Utah, have placed an order for a 130 h. p. Ball engine.

THE SUNBEAM INCANDESCENT LAMP CO.

It is generally understood that the Sunbeam Co. have made arrangements with the General Electric Co. Their case was pressed for trial and not being in position to present the Goebel defense in a manner that would be entirely satisfactory to the other companies that had gone to considerable expense in getting it into shape, they decided that it was not advisable at the present time and under the present circumstances to push that evidence in defense; and finding they could make an arrangement with the General Electric Co., which would relieve them from all liability for any claim of damage for past infringement, release all parties who had purchased lamps from them in the past at the same time, and in addition, allow them to convert into cash, material and lamps on hand at the factory, which were practically valueless under the present circumstances, they thought it was better policy to make this arrangement than to run the risk of going to trial and have a decree entered against them or to run under a bond, as the Sunbeam Co. has decided under any circumstances not to manufacture any more of the infringing lamps. This arrangement does not in any way bind or concern the Star Electric Lamp Co. and will not affect in any way the output of the New Sunbeam lamp. The Star Co. propose to go on and put the new Sunbeam lamp on the market and push the sale and output to their best ability. They are prepared to defend themselves against any litigation that may be brought by the General Electric Co. and believe that they are able to make a successful defence.

THE H. N. & H. FAN OUTFIT.

The accompanying engraving represents the H.N.& H. fan motor in which the principles of construction which have been found to give the best results in larger motors, have here been embodied with excellent results. As will be noted, the motor is of the horseshoe type, and built up of laminated sheet iron, stamped and bolted together. Its construction avoids all magnetic joints and affords a strong magnetic field with comparatively small magnetizing current.



The H. N. & H. Fan Outfit.

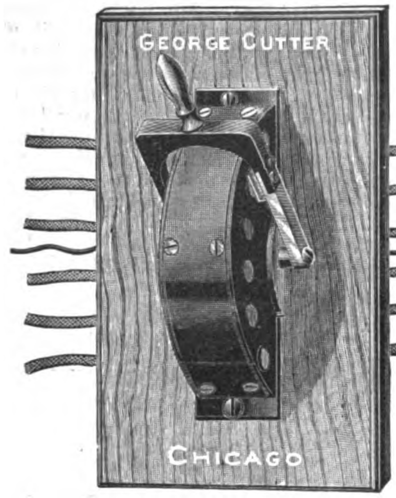
The armature is of the Siemens type with teeth; carbon brushes are employed which are held in sockets and pressed against the commutator by springs at their rear ends, thus affording a continuous feed until the brush is entirely worn out. To thoroughly protect the wire on the field coil the latter is encased in a polished brass covering, and the switch is mounted on the top of the machine on a small rubber base which serves to protect the amature from injury. All the parts of the motor are stamped from dies, and are interchangeable. The mechanical details have also been carefully worked out; the journals are extra long, and the shaft of large diameter, while oil cups of improved design provide continuous lubrication.

The motor is built to operate on 110-volt circuits, and a recent test shows that with a consumption of only .82 ampere the 12-inch fan revolved at 2,000 revolutions. The entire outfit complete, weighs less than 15 pounds.

The little motor is the design of Messrs. Newton Harrison, Mortimer Norden and Arthur Hammerschlag, who constitute the firm of The H. N. & H. Electric Company, 136 Liberty street, and who are now placing it on the market.

CUTTER'S VOLTMETER SWITCH.

The need of maintaining a uniform pressure at the lamps is being more generally appreciated every year and will undoubtedly lead to greater economy in incandescent lighting. The voltmeters reading anywhere within 10 or 12 per cent. of the mark, which were so common a few years ago, are being replaced by more accurate ones and there is a marked tendency towards keeping the voltage steadily at the fixed standard. In order to do this with quite a number of circuits, an equally large number of voltmeters have been commonly used, and these have almost always been cheap and inaccurate instruments. By far the better plan consists in using a single but first-class voltmeter for every eight or ten circuits and having a special device for readily connecting the instrument to any of these circuits.



Cutter's Voltmeter Switch.

The switch here illustrated by us was designed for this purpose, and is found to be admirably well suited to the work. It is built in sizes ranging from six to 16 points and being made entirely of brass, copper and hard rubber will look well on any switchboard. The maker is George Cutter of Chicago.

HELIOS LAMPS IN BALTIMORE.

Our Baltimore correspondent informs us that the contract between the Southern Electric Company of that city and the Helios Electric Company of Philadelphia has been cancelled by mutual consent.

NEW YORK NOTES.

New Use of the Lundell Fan Outfit. Amusement seekers during the hot summer months will appreciate the liberality of the management of the Fifth Avenue theatre and actors will bless it when they feel the cooling zephyrs that make the theatre a delightful resort. This invisible, inaudible delight is the result of experiments with a fan motor outfit. The Lundell outfit was chosen, particularly on account of its noiselessness. The boxes will have each an individual outfit and there will be a plentiful distribution of fans throughout the auditorium, stage and dressing rooms. The Interior Conduit & Insulation Company whose wiring system is installed in the building, furnish the Lundell Fan outfit.

Mr. Robert A. Keasbey, whose magnesia sectional coverings for steam pipes, boilers, etc., are known to everybody, has removed his offices to 54 Warren Street, this city, where his telephone call will be "1515 Cortlandt." The office is a great improvement over the old one; the storeroom is considerably larger, and a much more extensive stock will be carried. The innumerable friends of Magnesia will hasten to call at the new headquarters.

The Dahl Electric Co. are receiving orders for their 1 and 3 h. p. alternating power motors, faster than they can be produced at their present factory. They have several flattering letters from parties using them, some of which have contained duplicate orders. Within 30 days they will have their 6 and 10 h. p. motors ready for the market.

W. C. Callman & Co., of 136 Liberty street, room 116, are the New York State agents for the Feldkamp electric fans and motors. They handle also the Safety motor, and a large line of electrical supplies.

THE BERLIN IRON BRIDGE COMPANY'S NEW CATALOGUE.

The magnificent new catalogue just issued by the Berlin Iron Bridge Company, of East Berlin, Conn., marks, in many respects, the triumph of scientific principles in the building of factories, shops, central stations, power houses and other places, where there are aggregations of machinery. In other words, it is recognized that with brick and iron, or with iron alone, as the structural material, the best results are obtainable in economy of space, abundance of light, good ventilation, freedom from fire, stability and power of carrying great loads, and a minimum of repairs. All these considerations are of importance in building a factory or mill; and they become supreme when the architect has to deal with a central station for electric lighting or with an electric railway power plant and car house.

The lesson that wood is a bad material for central stations has been learned through many sad and bitter experiences, and the only wonder is that even to-day so many stations exist in which lumber has been employed and in which the construction is as ancient and poor as the apparatus it is designed to cover is modern and advanced. We have been glad to note the growing tendency to the use of iron and brick, and to publish frequent items as to stations in which iron appears as the roofing material. The new catalogue of the Berlin Iron Bridge Company includes several views and descriptions of such stations; and a glance at them shows how marked is the advantage and improvement.

The catalogue is an oblong quarto of 318 pages, nearly half of which are occupied by illustrations, the other half being devoted to excellent detailed description; so that in reality one makes a rapid and instructive survey of industrial building construction as practiced to-day on the most approved methods.

Additional to the buildings and data thereon, are cuts and details in regard to the iron poles for electrical work made by the Berlin Company. They are of graceful, durable construction, and are going into extensive use, though still quite new on the market.

NEW ENGLAND NOTES.

The Davidson Ventilating Fan Company of Boston, have at last got throroughly established in their new factory at Portsmouth, N. H., where they have erected a handsome brick building 150 feet by 50 feet. For the past few months orders for their well-known fans have been coming in faster than they can fill them, but now with their largely increased facilities for manufacturing, they are rapidly catching up, and will soon be able to meet the demand promptly. They are also selling numbers of Case engines for which they have the Boston agency, and which are becoming extremely popular where light power is required.

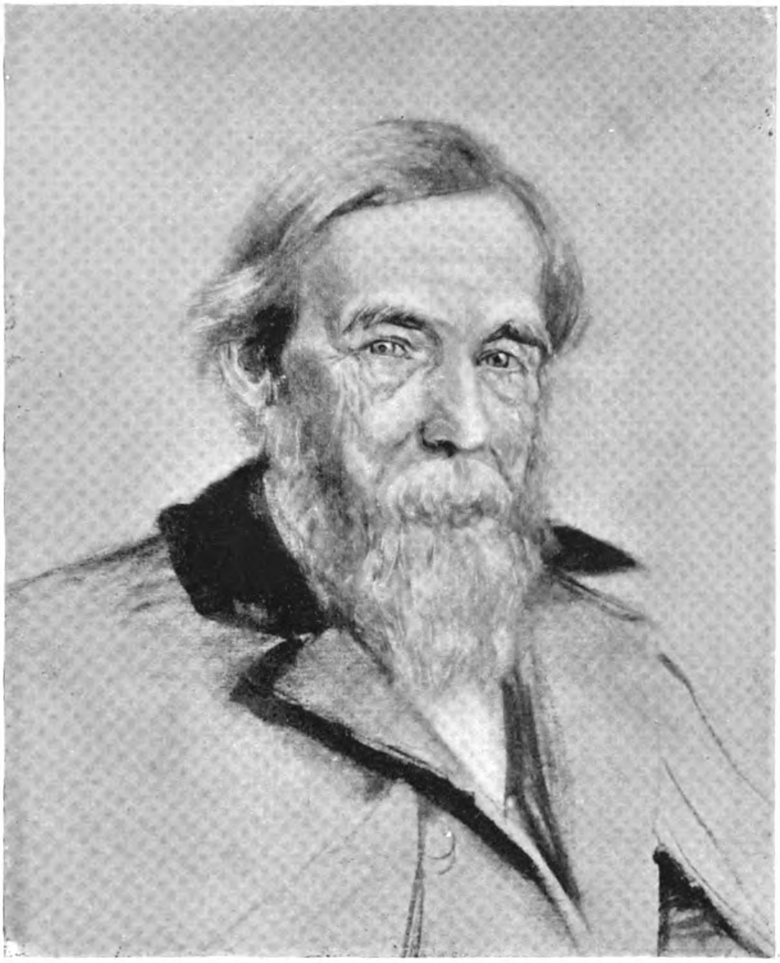
Cumner, Craig & Company, of Boston, have closed a contract for the electric equipment of the new building of the Boston Plate and Window Glass Company of Boston. A Crocker-Wheeler dynamo will be used, and there will be in all about 600 lights, arc and incandescent. Cumner, Craig & Company are now handling the manufactures of the Crocker-Wheeler Company, the Bishop Gutta-Percha Company, the Waddell-Entz Company, the General Incandescent Arc Light Company, the Frisbie Elevator and Manufacturing Company, the Star Electric Lamp Company, and the Interior Telephone Company.

The Brown Electric Company, of Boston, have closed a contract for the electrical equipment of the South Jersey Traction Company, of New Jersey, whose headquarters are in Philadelphia. The road embraces about 36 miles, joining a number of small towns in central New Jersey. The Brown Company were recently made New England agents (with the exception of Rhode Island) for the well-known Meston Fan Motors, manufactured by the Emerson Electrical Manufacturing Company, of St. Louis, and are already doing a large business in them.

Gillis & Gleason, of Boston, (successors to A. L. Russell) have published an interesting catalogue and price list of new physical apparatus, particularly adapted for the college courses in electricity and physics. The book is well illustrated and embraces nearly every piece of physical apparatus required in a college laboratory, as well as a number of instruments that can well be used in actual service.

The Russell Electric Manufacturing Co. of Providence, R. I., are now manufacturing an order of 650 mast arms for the Narragansett Electric Light Co. of that city. The arms are of the latest improved Russell pattern and combine many features of great value.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.



Moses Gerrish Farmer.

MOSES GERRISH FARMER.

FROM A RECENT PORTRAIT SKETCH BY FRANK H. TOMPKINS.

Engraved, by permission of the artist, for
THE ELECTRICAL ENGINEER.

Supplement to THE ELECTRICAL ENGINEER, N. Y.,
No. 266. Vol. XV. June 7, 1893.

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THE
Electrical Engineer.

Vol. XV. JUNE 7, 1893. No. 266.

EPISODES IN THE LIFE OF MOSES G. FARMER.

IN the last issue of THE ELECTRICAL ENGINEER an interesting biographical sketch was published of Prof. Moses G. Farmer, who died at Chicago on May 25. We are now glad to supplement that article by a few reminiscences and personal notes, bearing more particularly upon his development of the fire alarm system, and giving some details of his private life.

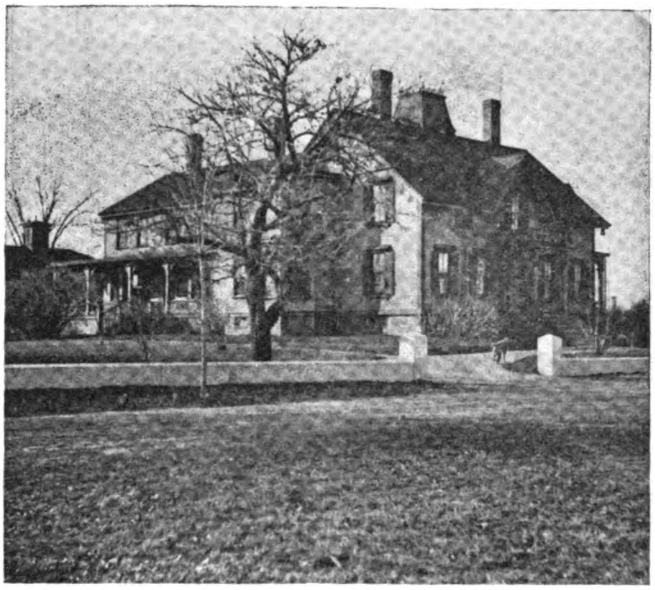
Owing to his conscientious scruples in respect to the Sunday work required of him in Framingham he secured a release from the telegraph office there, and removed in July, 1848, to Salem, Mass., taking charge of the telegraph office in that city, also of all the temporary repairs on the line between Boston and Newburyport.

In the autumn of 1848, he received an order from the city of Boston to construct two small machines for striking alarms of fire on church bells in accordance with the plans he had submitted to Mr. F. O. J. Smith. The machines were constructed at once by Howard & Davis, of Roxbury, Mass., and exhibited in Boston, December, 1848. One was placed on the clock of the Court House, and the other in the office of the superintendent of the New York line of telegraphs. These machines were connected by a wire, and were operated by a circuit of the main New York line, so that the bells to which they were attached were both struck simultaneously by an operator in New York city, 250 miles away. The experiment was regarded as an extraordinary feat by all who witnessed it, and glowing accounts of the event were published in the newspapers of the day. Mayor Quincy's term of office expiring soon after, and his successor apparently not feeling the necessity of further action on his part, the subject was not immediately resumed, and Mr. Farmer continued his experiments in other directions.

During the year 1849, he contrived an electromagnetic clock, with dead-beat escapement, and a continuity-preserving circuit-breaker. This clock had only three wheels, each with 60 teeth; the second hand moved each second, the minute hand each minute, the hour hand each five minutes. This was patented in 1852, and one of them was in use in the municipal fire-alarm office in Boston for several years after the introduction of the system into that city.

In February, 1851, he received a note from Dr. William F. Channing, of Boston, with whom he was wholly unacquainted, requesting an interview, and stating that he desired to use the machines which Mr. Farmer had devised and exhibited for giving an alarm of fire by electricity. Dr. Channing had published a suggestive and well-written article upon this subject as early as 1845, although Mr. Farmer had never heard of it, nor did he ever meet the writer until he called at his (r. Farmer's) office on State street. Dr. Channing had never attempted to devise or construct any machinery by which his idea could be demonstrated, and accordingly Mr. Farmer consented to the use of the machines which had been exhibited two years before, and also offered to assist Dr. Channing in operating them.

The experimental trial satisfied the city government of Boston of the feasibility of the plan, and an appropriation of $10,000, was made to carry it into effect. Mr. Farmer was appointed superintendent of the construction, and resigning his position on the Vermont line entered upon his duties in July, 1851, for this purpose. The work was no sooner undertaken than he found himself at sea without chart or compass. The system, which had appeared so simple and beautiful on paper, was only a skeleton which must now be clothed before it could become an obedient servant. How to solve this most difficult practical problem engrossed every thought. Novel machinery, appliances and fixtures had to be invented at every step. Every bell-tower required its peculiar adaptations. The position of the machinery, its size, and the weight to be attached to it, all had to be taken into account. Endless difficulties beset the young inventor at every turn. The appliances of the ordinary telegraph line proved utterly useless under the new conditions, but his absolute faith in final success bridged over the difficulties, one by one; and the work of construction went steadily on, until the last dollar of the original appropriation had been expended. The municipal fire alarm committee, to their credit be it said, never doubting Farmer's ability to accomplish the work he had undertaken, made another appropriation, and the task before him was pursued with the same untiring energy and wonderful fertility of invention, until success crowned his efforts. The first trial took place April 28, 1852, and the first alarm was sent out by Charles Carleton Coffin on the evening of the 29th.



BITTER-SWEET-IN-THE-FIELDS.
HOME OF PROF. MOSES G. FARMER, ELIOT, ME.
From a photograph by Marguerite Rogers.

Daily use of the system served to disclose its many defects and it is not too much to say that for the next three or four years it required literally sleepless vigilance on the part of Mr. Farmer, to overcome the obstacles to its complete and triumphant success. During the first 15 months after the Boston fire-alarm went into operation, he spent 43 nights in the central office in Boston, not daring to leave it long enough to return to his home in Salem. Twice he was sent for to return by carriage in the night. Once, in a terrific storm, he found it impossible to obtain a horse or driver. Being told that the storm was too terrible for man or beast to be out in, he simply replied :—"If I am willing to risk my life, you certainly ought to be willing to risk one of your horses." The request was granted, and he reached the central station in Boston long after midnight to find that his worst fears had been more than realized. Every wire connected with the main office had been broken by the storm. Had a fire broken out that night the city of Boston would have been at the mercy of the flames.

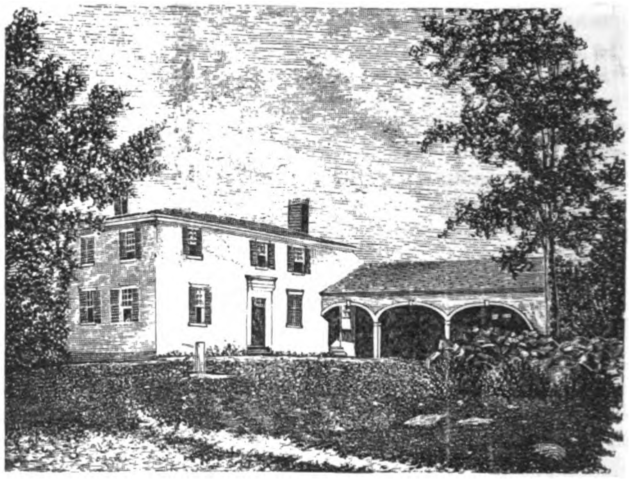
In 1852, Mr. Farmer devised other closed-circuit repeaters; also commenced the construction of apparatus upon the principle which has been so successfully worked out by Delany, for the simultaneous transmission of several messages upon one wire. In 1852–3, he made many original experiments upon rheostats, voltameters, and magnetometers. In 1853 he received a patent on an improved porous cell for galvanic batteries. In 1854 he turned his attentions to magneto-electric machines, and deposited copper in several cells placed in series, and endeavored to ascertain the value of mechanical power required to accomplish it. He also substituted magneto-electric machines for the galvanic battery, for striking the bells of the fire-alarm telegraph, and also applied water motors instead of weights to raise the bell hammers. He contrived and constructed the first resistance coil, with artificial electrostatic capacity, produced by winding sheets of tinfoil between each layer of wire. In the same year he made improvements in diaphragm water meters. In 1855, he invented improvements in double-current fire-alarm signal apparatus, making use of a current of one polarity to give one signal, and of the reverse polarity to give another and different one. The same year he experimented on dial telegraphs; also on duplex telegraphs for double transmission in the same direction; made experiments on electric signals for railroads; invented another printing telegraph; and made experiments looking to the construction of apparatus whereby two operators could send simultaneously, over one wire, from Washington to New York, reports in shorthand of congressional speeches. In the winter of 1855–6, he made successful experiments on the electro-deposition of aluminum.

Prof. Farmer was for many years a member of the American Association for the Advancement of Science. In 1884, he took part in the organization of the American Institute of Electrical Engineers, and in October, 1890, was made an honorary member, a distinction which at the time of his death he was the only American to enjoy, and which he shared with Lord Kelvin and Mr. W. H. Preece. To the very last day he took an active interest in the work of the Institute.

On June 27, 1891, his faithful companion, who had shared with him the joys and sorrows, the defeats and the triumphs of all his active career, was called away. From this time forward, life could never be what it had been, though with cheerful and patient resignation he continued to labor at his self-imposed tasks, cheered meanwhile by the tender ministrations of a faithful and loving daughter.

Prof. Farmer had but two children, a son who died in infancy, and a daughter, who has been a faithful assistant in his scientific work, and who survives him.

In the quaint old-fashioned garden of Bitter-sweet-in-the fields, almost under the windows of the study in which he spent the later years of his life, loving hands have laid him to rest beside the dearly-loved wife who had been for nearly forty years the inseparable companion of his joys and sorrows. A picture is given of this place. From a front window of this house, as she was wont in her lifetime to recall in half-humorous reminiscence, one bitter winter day, the wife for the first time beheld the face of the man whose life was to be so inseparably linked with hers. A youth of scanty means and somewhat uncouth appearance, but of high purpose, he passed by the lonely farm house on foot, buffeting the chill blasts with determined courage in his search for a chance to teach a country school. It was before the days of professional tramps. The matron of the house was just setting upon the table a savory dish of soup. Upon the impulse of the moment, her daughter said, "O, mother, such a frozen-looking fellow is going by! Do let us ask him in to have some of our hot dinner." "Yes, child," responded the mother, with the old New England instinct of instant hospitality, and out of the door bounded the young girl, to bring the wayfarer in. As she reached the gate, a sense of the unconventionality of the invitation overpowered her; she turned and fled incontinently into the shelter of the maternal kitchen. But the observant eye of our embryo philosopher had not failed to note the sprightly manner and the attractive face, and in laughingly relating the incident an hour later, to the hostess where he stopped for his noonday meal, young Farmer observed that she was not very unlike the girl he might like to marry some day. And so the Providence which we call fate, indeed willed it, for within a few months the youth was installed as pedagogue in that same village, and among his pupils was the sweet-faced girl whose mother's hot soup would have been so well relished if only he had received the well-intended invitation to share it. One is irresistibly reminded by this anecdote, of Benjamin Franklin's first entrance into Philadelphia; walking, as he has told us, up the principal street of that quiet village with a baker's roll under each arm, while the eyes of his wife-to-be watched him from a window as his vigorous country appetite made way with a third.



Birthplace of Moses G. Farmer, Boscawen (now Webster), N. H.

The readers of The Electrical Engineer will no doubt be interested in the view which we give of this historic house, in which Professor Farmer first saw the face of his future wife; in which he was married, and in the garden of which he now rests from his earthly labors. A view of his birthplace is also given, a farm house in that part of old Boscawen, N. H., which is now Webster, the district being better locally known as Bashan. The accompanying portrait of Professor Farmer has been reproduced by permission, from a yet unfinished sketch in oil by Frank H. Tompkins, of Boston, and will be recognized as a most characteristic and striking likeness.

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T. COMMERFORD MARTIN AND JOSEPH WETZLER.
World's Fair Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—680 Atlantic Avenue Boston, Mass.
Western Editor and Manager, L. W. COLLINS, 948 Monadnock Building, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 501 Girard Building, }

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VOL. XV. NEW YORK, JUNE 7, 1893. No. 266.

FINANCIAL ASPECTS OF ELECTRIC LIGHTING IN NEW ENGLAND.

IT would appear from the action recently taken by the inhabitants of Melrose, that the fever of "Nationalism" is not spreading quite so quickly in Massachusetts as it first did. A fit of chills is now on. The town meeting at Melrose voted 394 against 205, upon the question of a municipal electric light plant, in spite of the perfervid eloquence with which the community had been flooded by Nationalists just before the test of strength. In other words, the vote showed almost a two-thirds majority against, instead of the expected and necessary two-thirds majority in favor. What makes the incident more striking is to find a newspaper at Peabody, where such wonderful municipal results have been heralded, expressing regrets that Peabody, like Melrose, did not await "the sacrifice of some other town near home."

A stronger argument perhaps than any in the campaign has been the small showing of profit made by the Massachusetts electric light companies, according to the unchallengeable report of the State Gas and Electric Light Commissioners—recently noted in our columns.

A study of the balance sheets of the several electric companies and of their receipts and expenditures for the year, as given in the report for the year ending June 30, 1892, brings out two or three facts in very prominent relief. One of these is, that of the companies operating in cities and towns, say of 10,000 inhabitants or less, very few are making any money, or from present appearances are likely to make any in the near future, while those of the smaller of these towns, of, say, 5,000 inhabitants or less, if inevitable depreciation be taken into account, are manifestly running behind. In the larger cities of the state, the present condition and prospects of the electric companies are much better, and this is especially the case with those companies which had the sagacity, not only to choose a favorable field of operations, but to expend money freely at the outset in securing permanent and thorough installation work. But of the total number of 84 companies in the state engaged in supplying electric light only 16 report having earned enough to enable them to pay dividends of 6 per cent. or more, in most cases, leaving depreciation out of the question. The unsatisfactory condition of affairs with many of the smaller concerns will appear from the following tabular statement, which is made up from a dozen selected from a much larger number in different parts of the state :

	Investment.	Receipts.	Expenses.	Gain.	Loss.
Adams E. L & Power Co.	$34,870	$9,552	$7,567	$2,385	....
Andover Elec. Co...............	58,693	9,132	9,023	109	....
Blue Hill Elec. Co...............	37,930	4,518	4,270	248	....
Bridgewater Elec. Co	30,300	4,186	5,066	....	$880
Gt. Barrington E. L. Co......	35,275	6,388	6,146	242	....
Leicester Elect. Co.............	47,170	4,598	3,896	702	....
Millbury Elect. Co..............	33,753	3,980	3,377	603	....
Nantucket E. L. Co............	57,740	5,406	4,148	1,257	...
Orange E. L. Co	38,164	6,417	6,871	....	454
Palmer Elec Co.......	71,094	6,309	4,859	1,450	....
Plymouth E. L. Co...........	128,833	6,345	14,401	1,944	....
Winchendon E. L. & P. Co....	25,957	3,878	4,153	. ..	275
	$599,784	$80,709	$73,776	$8,940	$1,609

Here is an aggregate investment in round numbers, of $600,000, which, if put into any fairly remunerative manufacturing enterprise, might reasonably be expected to return net earnings of at least $60,000 per year, in order to provide for 6 per cent. dividends, depreciation and renewals; instead of which the returns show of actual net earnings the beggarly sum of $7,331. There can be but one conclusion from a study of the above and many other similar cases which appear in the returns, and that is, that the electric light is being furnished in many places at a less price than can possibly be afforded. The returns show that in most of these smaller towns and villages, the yearly contract price per 16 c. p. lamp seldom exceeds $10, and in some cases is as low as $8, while the most usual price by meter is 1 cent per ampere hour. Lamp renewals are usually made at the expense of the company, while interior wiring is sometimes done free, and sometimes charged at cost. The only apparent way in which the greater number of these companies can avoid ultimate bankruptcy, is by raising the price of service to the figure at which it ought to have been put in the first place, say 1½ cents per ampere hour; abolishing contract service, free renewals and free wiring, and putting the whole business on a "business basis."

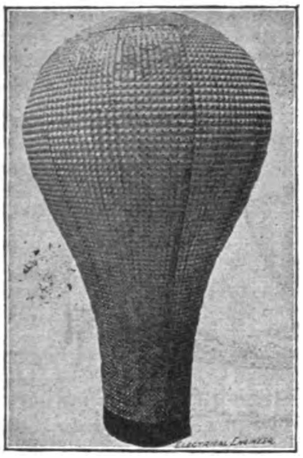
It seems evident that this is hardly a business that municipalities should venture into debt on. Rather should they encourage the young companies by the grant of reasonable privileges and concessions, so that the capital invested will be ready to risk itself on all the later advances in the art that come forward with the promise of cheapening the generation, distribution and utilization of current.

Prof. Moses G. Farmer.

OWING to the short notice of Prof. Farmer's death last week, none of the portraits given of him was at all satisfactory. We have endeavored this week to reproduce, carefully, as a frontispiece, a portrait upon which the artist, Mr. Tompkins, was at work at the time of Prof. Farmer's death; and we think it will satisfy all who knew the great electrician or who, not knowing him but admiring his genius, desire to possess a faithful picture of him.

WORLD'S FAIR DEPARTMENT.

THE TOWER OF LIGHT IN ELECTRICITY BUILDING.



30,000 *Crystals.*

PROBABLY the most noticeable feature of Electricity Building is the "Edison Light Tower," unveiled and illuminated on June 1, with the accompaniment of the elaborate ceremonies described on another page of this issue. This beautiful tower, standing centrally within the Building so as to catch the eye from every point of view, is not the first of its kind by any means, but it is certainly the finest. Its talented designer, Mr. Luther Stieringer, had already tried his hand very successfully in this direction at the Lenox Lyceum, New York; the Minneapolis Exposition and the Portland, Ore., Exposition; and he has in this attempt availed himself of all the experience thus gained in a very esoteric and difficult branch of decorative electricity. I am glad to be able to show herewith a picture made directly from a photograph of the Tower, taken this week. It is true that the photograph differs very much from vivid pictorial "sketches" that have been given the electrical public already, but I trust that the accuracy of the camera will not therefore be impugned or vilified.

This tower, due to Mr. Stieringer, and erected by the General Electric Company, is intended to represent the triumph of the incandescent lamp and to signalize at the same time the genius and perseverance that carried Mr. Edison to its perfection, so that to-day the incandescent lamp is largely and popularly known by his name. The tower rises to a height of 82 feet and the circular pavilion out of which it springs is 32 feet in diameter. The shaft is cylindrical and its surface is marked with well-defined molding in geometrical designs. The pattern is accentuated with over 4,000 small incandescent lamps of 5 c. p., red, white and blue; and the ribs of the pavilion roof are similarly picked out. At the top of the column is a huge prismatic bulb built up with infinite pains out of about 30,000 separate pieces of crystal. I have shown it in a little vignette from a photograph furnished by its manufacturers, F. McLewee & Son, of New York City. The bulb weighs about 1,000. pounds. It is about eight feet high and four feet in greatest width. The prisms are made of fine cut glass each about three-quarters of an inch in diameter. The effect is superb. It is a pity the statue of Liberty could not hold aloft such a crowning glory of flashing light.

Under the colonnaded pavilion is the superb exhibit of the Phœnix Glass Co., in charge of Mr. Fox, with special reference to their glassware for electrical purposes. The glass shown is considered the finest that this continent is capable of producing, and fully the equal of anything European. The decoration includes large cut-glass globes and dishes, stalactite shades, gossamer glass, mirrors and crystals in profusion, all harmonizing perfectly with the other parts of the tower and adding to the marvelous beauty of the spectacle.

In Figs. 2, 3, 4 and 5,—all of which I have been allowed

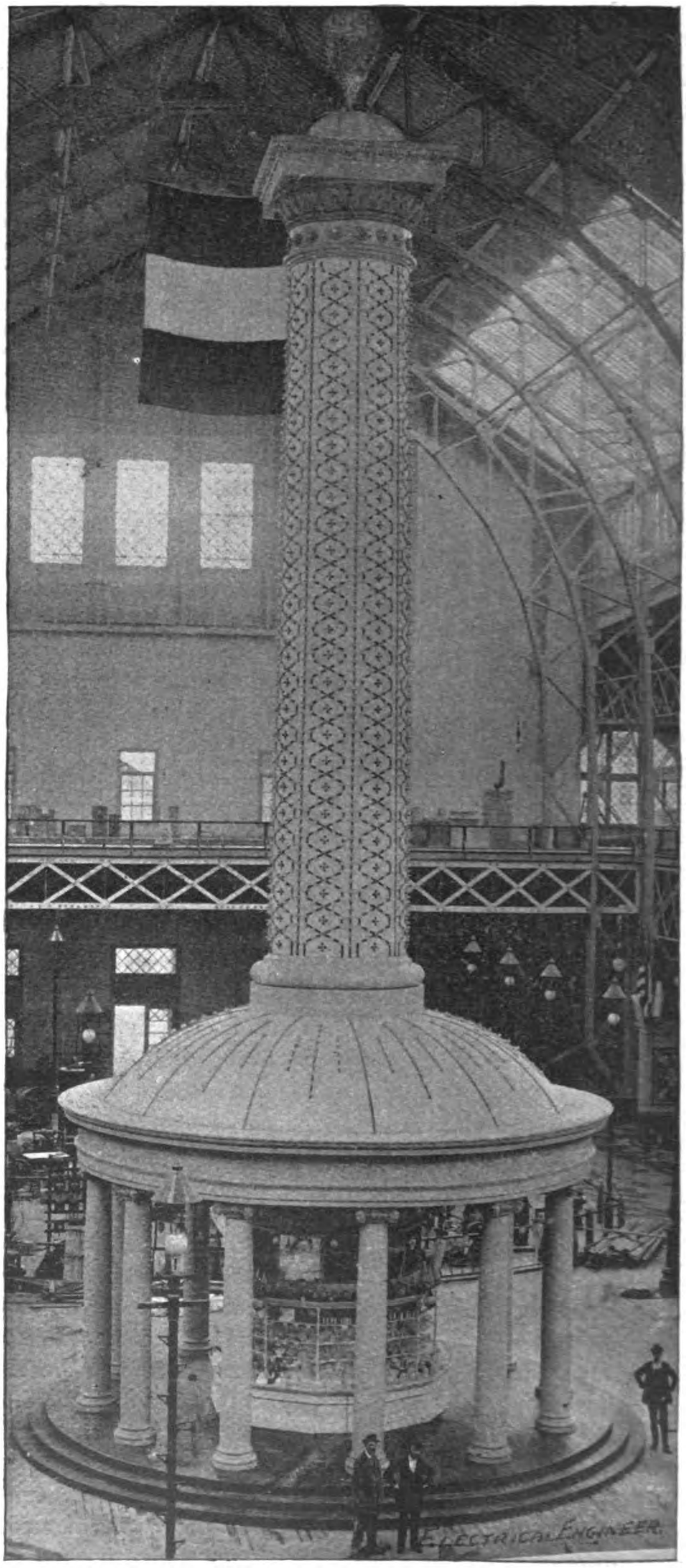
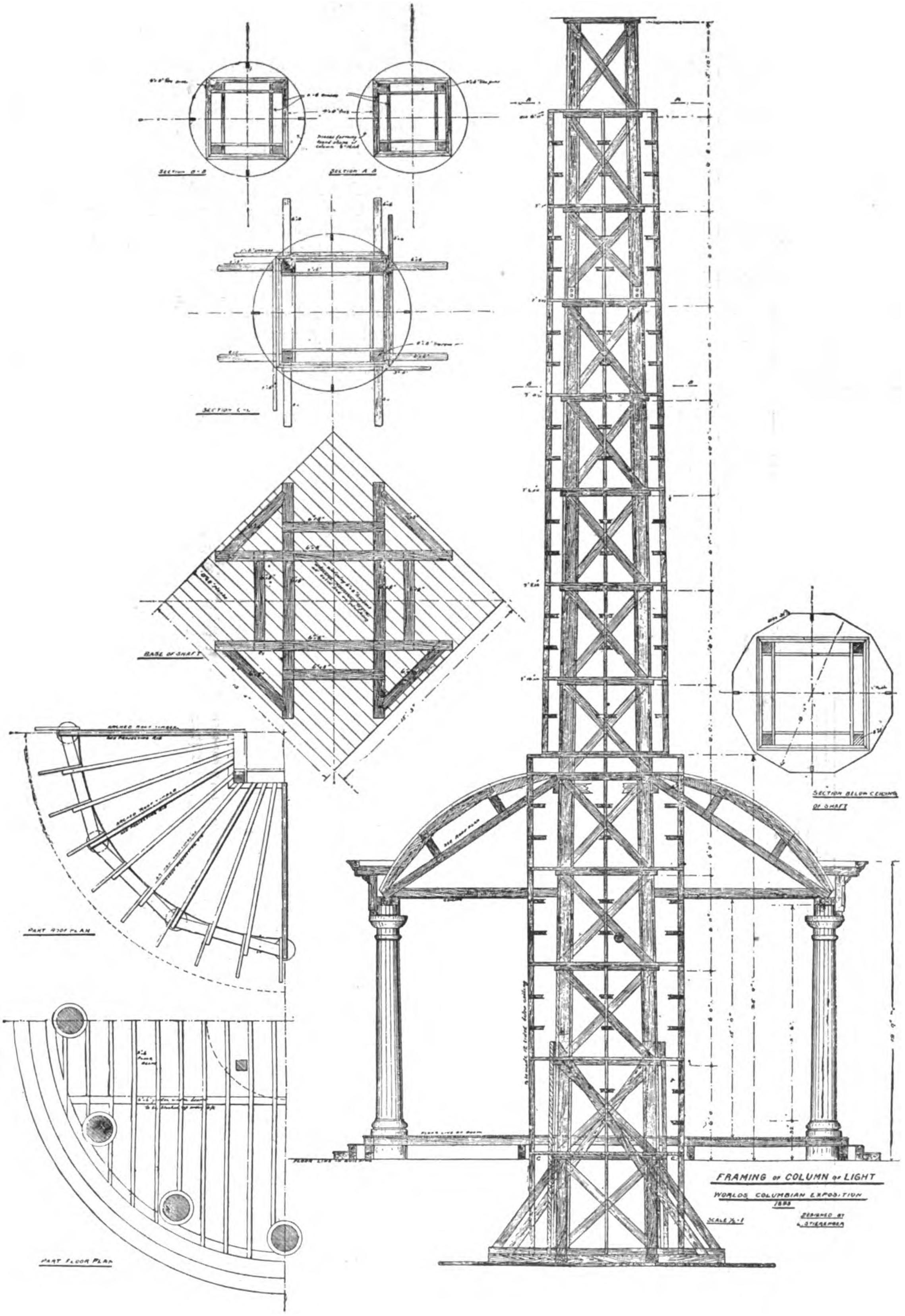


FIG. 1.—THE EDISON LIGHT TOWER, WORLD'S FAIR.



FIGS. 2 AND 3.—DETAILS OF CONSTRUCTION OF THE EDISON TOWER OF LIGHT, ELECTRICITY BUILDING, WORLD'S FAIR.

to make from the official tracings actually used on the work, and which are therefore, I venture to hope and believe, presumably accurate,—I show the details of the construction of the Tower. The circuits are so arranged and manipulated that the lights can all be thrown on or off at will, and the principle of subdivision is carried out in such

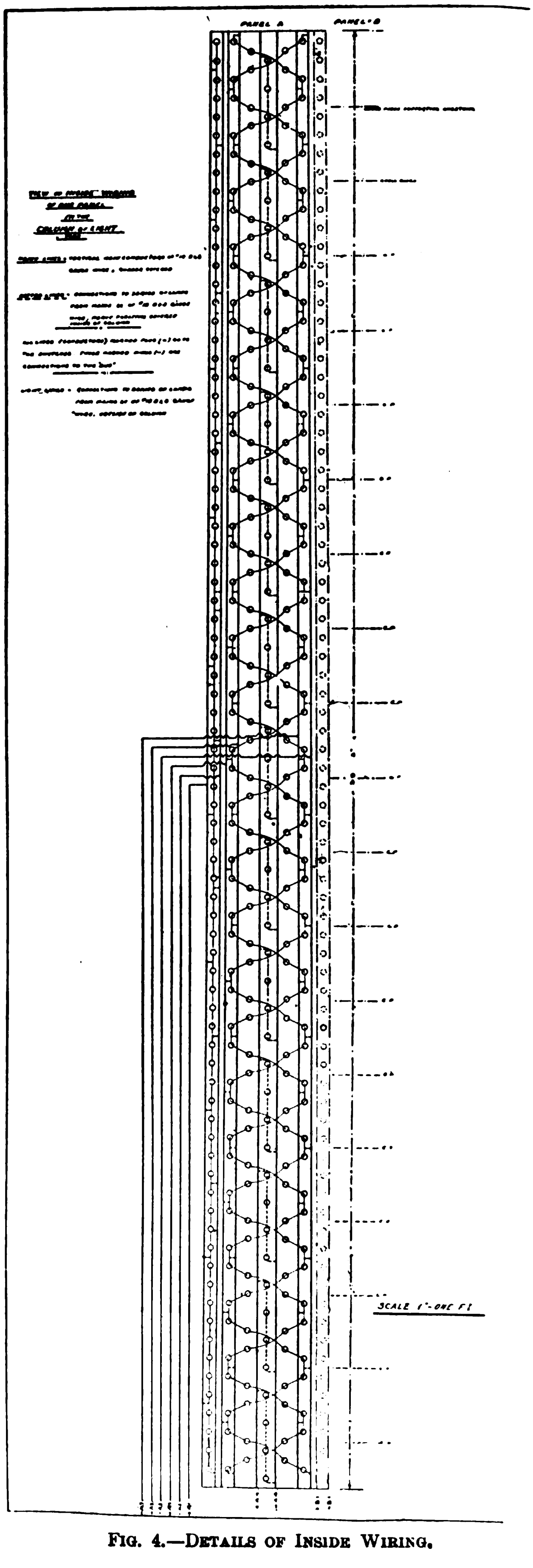


Fig. 4.—Details of Inside Wiring.

a manner that, as described in my notes in this issue on the opening of the Electricity Building, colors and rows and groups can be worked independently or blended in any desired combination. The control is as instantaneous and flexible as that of a keyboard.

The wiring of the entire Tower has been done in strict accordance with the rules of the National Board of Fire Underwriters, the highest grade of rubber-covered wire being used throughout and strung upon porcelain insulators. Speaking tubes run up and down the interior of the Tower, and are of great service in its operation. The mains run to a three-wire centre of distribution board in the base of the Tower from which current is sent out to busbars. From these branch 62 circuits, the wires being led to about the centre of the Tower, at which point they are tapped in to the wires leading to the lamps. Each circuit is controlled separately and independently by a quick break General Electric snap-switch of the Edison style and protected by an individual cut-out.

Three miles of wire were used for the completion of this great work. The lamps are of five c. p., placed four in series on a 114 volt circuit. The big lamp at the top, composed entirely of six-sided cut-glass prisms as described, is lighted from within by lamps arranged four in series, like those in the main tower.

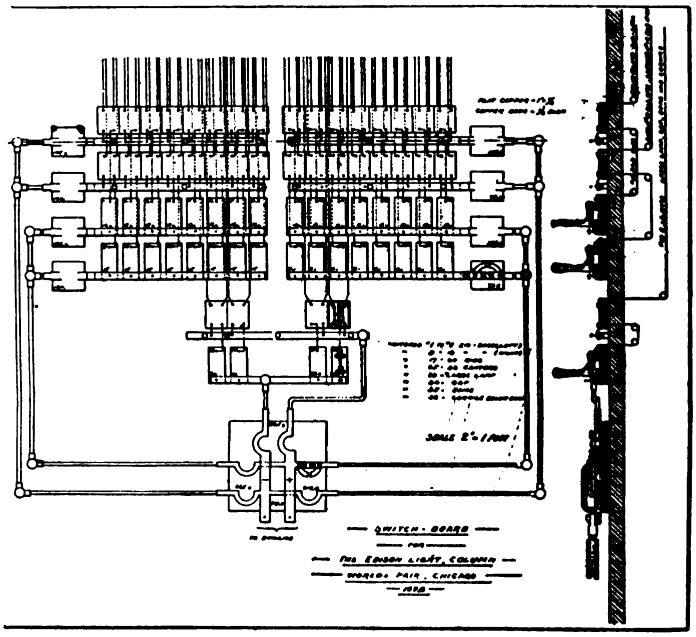


Fig. 5.—Plan and Sectional View of Switchboard.

The Tower intended primarily to show the wonderful progress made in lighting by incandescent lamps since its introduction in 1880 by Mr. Edison certainly achieves its purpose most brilliantly. While the same class of displays have been made before, there has never been attempted hitherto any work of such magnitude as this. The entire installation has been made throughout as though it were intended to be permanent. There is not one particle of "temporary" work from top to bottom.

Mr. E. W. Hammer, who, it will be remembered, superintended the construction of the Minneapolis Tower and the Edison display at the Lenox Lyceum at New York, has had the entire supervision from the first, and the work has been carried out under the superintendence of Mr. W. J. Cetta. It was of course necessary to train all the men specially for the work, as it was of an entirely new character; and great credit attaches not only to the designer but also to those whose personal supervision and unremitted attention has brought the whole to such a successful and beautiful result.

THE OPENING CEREMONIES IN THE ELECTRICITY BUILDING.

It would be difficult to imagine a more beautiful and striking scene than that which presented itself to those within the walls of the Electricity Building, at the World's Fair, on the evening of June 1st. The exhibitors all vied with each other to produce odd and effective bits of lighting and with bunting hung from every available corner, the opal globes of the arc lamps casting a soft radiance over the crowds of people, the search lights playing from point to point, the strange streaks of light shooting about the spaces of individual exhibitors, and in the centre the great white sheeted tower, the sight was not one to be forgotten. About 7.50 p. m., the musical programme was begun by Soussa's orchestra, seated in the gallery in the east transept, and during the rendering of the second selection the tower was slowly unveiled.

Focusing lamps in the balcony were flashed upon its white surface as the covering fell, and brought into clear relief the geometrical arrangement of the lamps and molding, and the graceful detail of the capital and played upon the myriad façets of the fixtures and globes of the Phœnix Glass Co.'s exhibit occupying the space at the base. As the first notes of the Blue Danube waltz were heard, the first lights were switched on in this space. Then the roof of the pavilion was striated with rows of brilliant colors, appearing and disappearing, and at the same moment the great lamp surmounting the whole flashed out a pure white glow. Then, in perfect time to the music the long single rows of lamps from top to bottom were flashed on and off; beginning at one side and traveling one by one around to the other. The diagonals then took part, coming and going, still keeping step with the rhythm, until as the waltz closed every lamp shone out and the whole tower was one blaze of glory. The colors are so happily chosen that, while each may have its full value when individually shown, no one subordinates the others while all are visible and the effect is indescribably soft and beautiful.

John P. Barrett,
(*Chief of the Electrical Department, World's Fair.*)

At the commencement of the next musical number all the incandescent lamps except those at the base were cut out and the search lights again played alone about the building. The tower lights after this were turned on from time to time during the evening and brought out the hearty cheers of the audience and the unbounded admiration of those who realized the magnitude of the undertaking and the difficulties overcome by the designer and his assistants.

Some amusement was caused on the night of the illumination by the publication, in a Chicago evening paper of an article purporting to be descriptive of the tower in which the entire credit of the undertaking was ascribed to World's Fair officials, whose duties are, and have always been wholly administrative.

At the moment of the lighting of the General Electric tower the beautiful golden pavilion just completed by the Westinghouse Company near the northern end of the hall was brilliantly outlined with incandescent lamps and interiorly illuminated by two large arcs of graceful ornamental workmanship. The company are to be congratulated on the rapid completion of this valuable addition to the architectural features of the Electricity Building and will soon at this rate have their entire exhibit finished. At the extreme north end the French revolving light houses shot their gleams into the eyes of the spectators, but otherwise helped wonderfully the brilliant effect.

During the whole evening the Bell Telephone temple was thronged with people listening to musical selections over the wires.

The fantastic and striking Egyptian tomb of the Western Electric Co. was also brilliantly and beautifully lighted as usual, while up their tower and along the streamers stretching beneath the balcony the rapidly moving lights chased each other to the mystification of the public.

Taken all in all, the opening was a perfect success from beginning to end.

THE THOMSON ELECTRIC UPSETTER.

In our last issue mention was made of the ingenious electric upsetter which forms a part of the exhibit of the Thomson Electric Welding Co., and I am now enabled to give our readers further details of this machine.

The method at present employed, of fastening the spokes to the tire cold, practiced by manufacturers of agricultural machinery, is open to the great objection that by that process the steel generally becomes crystallized under the blows of the hammer, and hence causes a weakness. The electric upsetter is intended to overcome this difficulty.

Our engraving, Fig. 1, shows the machine in perspective, and Fig. 2 shows the heading tool, and the converter in part section. The upsetter consists of a cam shaft driven by a set of gears from another shaft connected to any source of power in the usual manner. A clutch, controlled by a lever seen in a diagonal in front of the machine, permits the cam shaft to be thrown out of gear instantly, the first shaft being kept going all the time. From the cam shaft, connection is had respectively with: First, the upper sliding clamp carrying the heading tool; second, the lower clamp which is lowered and raised; third, the clamp lever of the lower clamp which is opened and closed to grip the spoke; fourth, the breakswitch which automatically closes and opens the primary circuit of the transformer.

The latter is not shown in the engraving as it occupies the rear of the apparatus. It is of the copper clad type, that is to say, the secondary is composed of two rectangular copper castings of a U section, the two being screwed together thus, ⊂⊃, leaving a hollow space to receive the primary coil. The secondary, magnetically and mechanically speaking, completely surrounds or envelopes the primary. For insulating purposes, the space intervening between primary and secondary is filled with oil.

Fig. 2 shows the manner in which the current generated in the secondary is conveyed to the heading tool and clamps. The heading tool slides in a rectangular groove of a large copper casting, on the rear of which the whole secondary (including the primary) is suspended, by means of a tongue snugly fitting in a slot and swinging around a pin passing through both. The lower part of the secondary leans by gravity against the lower movable clamp which slides in guides. To insure perfect contact, a ball and socket joint is interposed between the secondary proper and the sliding clamp. Through these contacts, currents of 10,000 amperes pass, while the machine is in operation. The capacity of the transformer is 20,000 watts with a primary voltage of 300 at 50 cycles per second.

The machine illustrated, is operated in the following manner: A wheel is placed on spindles with one of the spokes between the jaws of the lower clamp; the clutch is closed by a lever. The cam shaft when revolving, causes first, the lower clamp to rise so as to set the rim in proper position relative to the hub; then, to close the jaws thus gripping the spoke; next, the heading tool to descend; next, to close the primary circuit and heat the spoke. During this time the heading tool, through which current enters the spoke is being held in contact by a spring interposed between itself and the upper clamp. The spoke once heated is now upset and riveted by the heading tool descending to its lowest position. At the same time the primary circuit is interrupted. The lower jaws now open and the whole clamp falls back to its original position, the same thing being done by the heading tool.

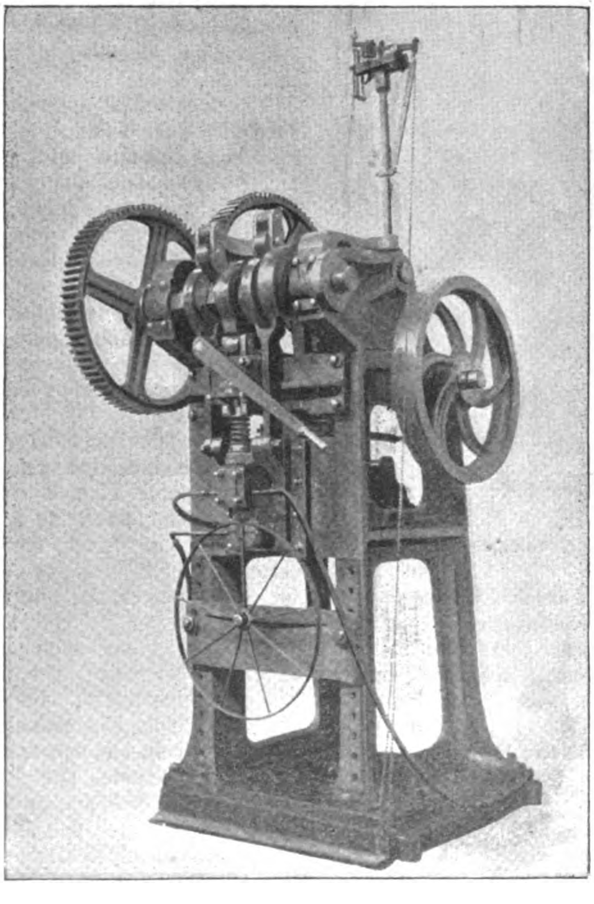


Fig. 1.—The Thomson Electric Upsetter at the World's Fair.

During the time the jaws are open the operator has to tilt the wheel and turn it around to insert the next spoke. This is the only part of the machine which is not automatic. By means of the clutch the mechanical part can be stopped and started at any moment. By a treadle and supplementary chain the electric circuit can also be opened at will independently of the automatic control.

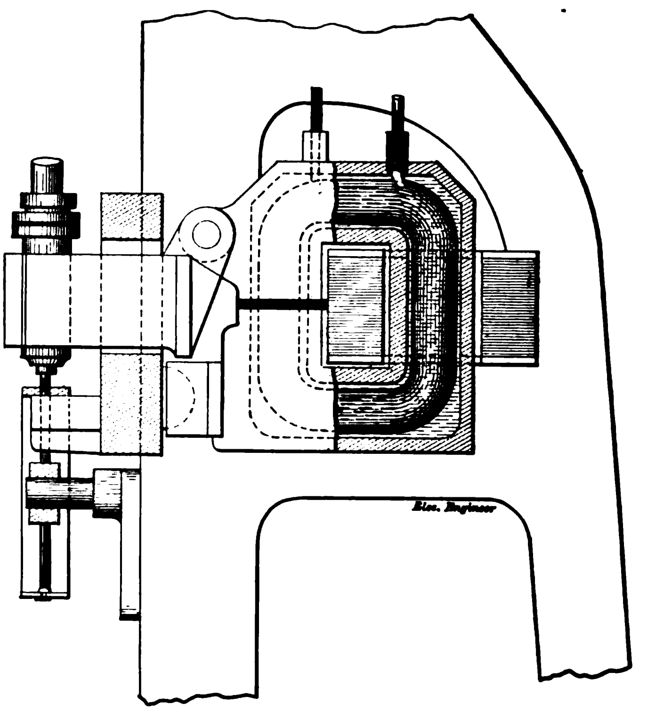


Fig. 2.—The Thomson Electric Upsetter.

This machine can, with slight modification, be made to upset the spokes in different ways as, for instance: First, by letting the tire be sprung out of the normal position to be brought back by riveting; second, to force metal through the hole of the rim and upset it from above; third, like the second method, with an additional motion of the lower clamp to press the metal previously forced through the tire from below as well as from above; fourth, the wheels are run through the machine twice, making first a series of upsets on the outside and then on the inside by raising the pin, around which the wheel is revolving as a centre.

This machine can upset on an average 3,000 spokes in a day of ten hours. The power required varies with the size of spoke and is approximately 50 h. p. for ⅝-inch stock, for a period of five seconds.

PROF. FARMER IN CHICAGO.

It has been mentioned that Prof. Moses G. Farmer, in spite of his physical feebleness went to Chicago in order that he might see the World's Fair, and enjoy all its beauties and wonders. His keen interest in all that was going on around him was manifested in many ways, and through all shone his native modesty and worth. A letter from him to Mr. W. J. Hammer dated from Chicago, April 26, 1893, takes note of the recent Wallace articles by Mr. Hammer in The Electrical Engineer, and speaks of other pioneers. It closes as follows:—"I have added but little to the world's knowledge. There must be just so many cobblestones in the grand electric edifice, and I am just as well satisfied to have been a cobblestone as a capstone."

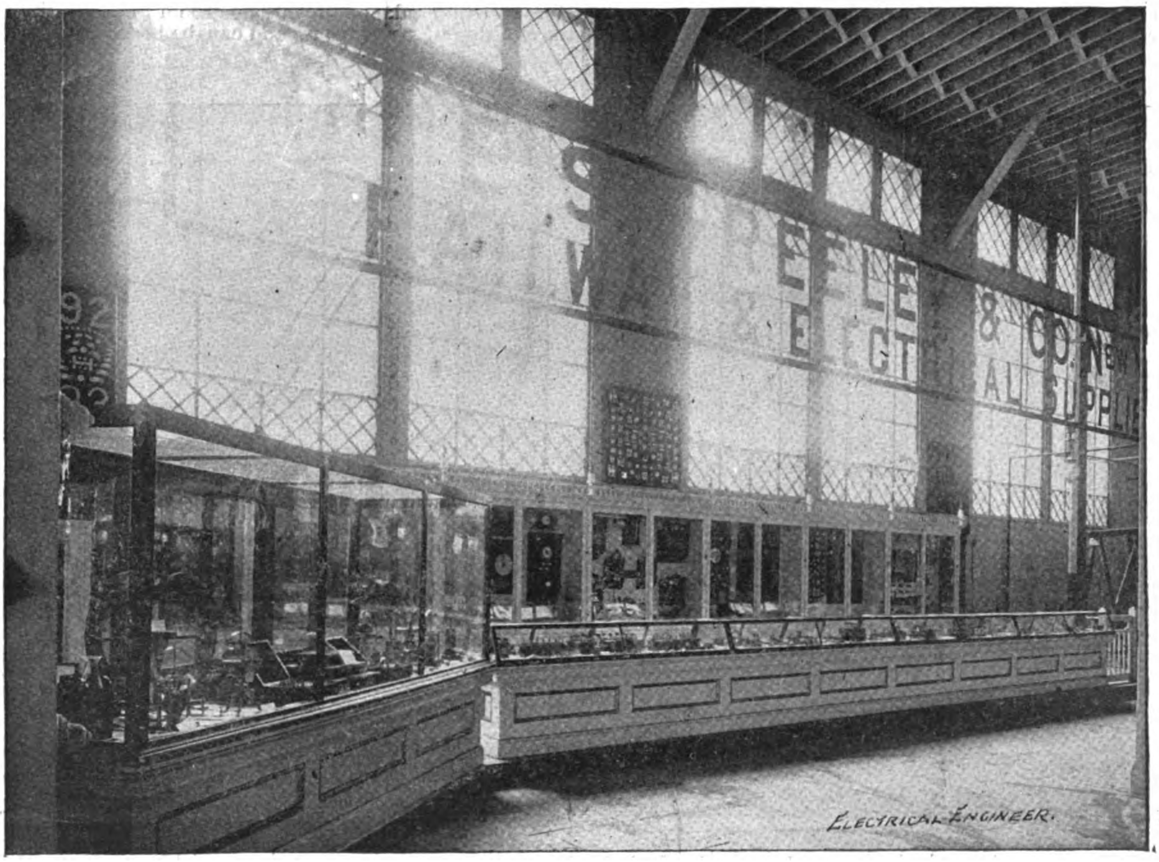
NOTES OF THE FAIR.

An illumination of the battle ship "Illinois" took place on June 3. when the ship was lighted above decks with Chinese lanterns, carrying incandescent lamps inside. She looked very pretty.

The German section in Machinery Hall was formally opened on June 1. It includes the dynamo plant. There were speeches, champagne, etc., and Germans were glad to find their country so well represented in this department.

THE E. S. GREELEY & CO.'S DISPLAY.

The E. S. Greeley & Co., makers of the golden key that unlocked the Exposition, occupy a large space in the northeast corner of the Electricity Building, where under the direction of Mr. Louis J. Auerbacher, a very complete and attractive exhibit has been completed. The space occupied is shown in the two accompanying illustrations, its long and narrow character preventing its being photographed on one plate. Starting at the northern, or left hand, end the first object of interest is a table upon which is mounted a Western Union jack switchboard connected with various combination sets of registers, relays and Victor keys. Here are also one and two pen district registers, and the first four-pen district register ever built. The main lines of these instruments are operated by Foote pinnacle blue-stone batteries and the local lines by Union Electric accumulators. At the front of the space stands a pyramid made up of 86 varieties of primary batteries, surmounted by a model of the Bartholdi Statue of Liberty holding an incandescent lamp, while near by is a showboard with a fire-alarm indicator, gong, tell-tale and alarm register, showing the actual operation of the fire alarm systems and how the calls are received and recorded at the engine-house. The alarm-boxes connected with these instruments are mounted on four posts about the enclosure so that the whole system has a very life-like look. The Foote pinnacle battery also furnishes the current for these instruments. A beautifully made 50-wire Western Union switchboard occupies a position immediately in the rear of the fire-alarm exhibit, and is left open at the back in order to show the workmanship and the arrangement of its interior construction.



The E. S. Greeley & Co.'s Exhibit at the World's Fair.

All along the wall from the "office" to the end of the space are high cases, each containing a large board covered with interesting apparatus, while instruments too large for the boards, or having legs of their own to stand on, are arranged in classified groups on the floor of the cases. Here are shown electric light snap switches of all sorts and kinds made by the company. One board is called the "electric piano" and has arranged upon it fifteen bells tuned to the chromatic scale and operated by Victor keys. The same case contains a collection of large iron frame bells and a number of chloride of silver dry battery boxes. A return call hotel annunciator of superior design and finish is the next thing that arrests attention, and with this are shown a ten station watchman's time detector, burglar alarms with clock cut-off and with an automatic electric light attachment by means of which the dial is instantaneously illuminated when the alarm sounds; annunciators with pneumatic reset and quantities of miscellaneous instruments of the same character. In these cases are also portable tachometers, speed indicators, wire gauges, thermostats and medical batteries. Some very handsome push buttons of silver, nickel, bronze and brass, oxidized, plain, and finished in several entirely novel styles occupy one case in company with more gongs and medical batteries with Leclanché, Exeter and Vesta cells. An ebony board with nickel push buttons and one of cherry with bells and their parts in various styles of finish make a pretty display in another case. In the last of the row is a Western Union pin switch board, a "W. B. G." fuse protector for telephone, telegraph and fire alarm circuits, arranged to fuse accurately to within $\frac{1}{10}$ ampere, an open circuit electro-mechanical gong in which the hammer is actuated by a powerful spring released by an electromagnet, and a number of Geissler tubes and rotators. The wall cases are of white and gold and are ornamented by little Liberty Statues a foot in height placed at intervals along the top, each holding aloft a three candle-power lamp of red, white or blue. The cases are lighted within by pendant lamps in "Paradox" reflector shades, each of a different pattern or material. Jack knife station switches, porcelain cut-outs and porcelain insulators are arranged on boards above in the spaces between the window, the last in such a way as to form the dates "1492—1893."

In the row of glass cases at the front of the space are shown telegraph instruments, including sounders, keys, relays, switches etc.; test instruments, rheostats, sine, tangent and astatic galvanometers, resistance boxes, testing keys, portable testing sets and standard adjustable condensers. Here also are the Frey compensating shunt, electric balance or reversible bridge, and magnetic brake for checking the oscillations of the galvanometer needle. The most conspicuous place in the most conspicuous case is naturally occupied by the gold Victor key on its plush stand surrounded by a coil of wire forming part of the original circuit of May first. In the same case is a Frey portable, self-adjusting galvanometer having a key that locks the instrument when not in use and at the same time lifts the fibre suspension for convenience and safety of transportation. Other instruments are a very sensitive Thomson tripod galvanometer, a ballistic galvanometer, Mascart electrometers, Rowland two and four coil galvanometers, six portable testing sets of different kinds, post office pattern Wheatstone bridges, Frey-Bailey combination testing sets, lamp stands, scales, Victor cable keys, telegraph lightning arresters, plug cut-outs, etc.

In the office are electric locomotive headlights and steam gauges, and a board covered with car trimmings and other castings in brass and bronze. The whole space is lighted by two "Success" arc lamps and 50 incandescents connected with a switchboard in such a way that when the incandescents are cut out the arcs light up, showing the relative illuminating power of the two sets.

LITERATURE.

Electric Lighting and Power Distribution. Part II. By W. Perren Maycock, M. I. E. E. *London and New York*, Whittaker & Co. Illustrated. 233 pages. 5x7 in. Price, 75 cents.

In this part of his work the author takes up dynamo machines and motors. The descriptions of the various types of machines we are glad to note do not as usual, consist in a mere picture of the machine, but wherever necessary the author has added diagrams showing the methods of winding, which will be found of considerable aid to the student. In the description of the action of motors, he has added a number of diagrams which clearly show the principles involved in the operation of these machines.

The final chapters of the book are devoted to the explanation of the characteristic curves of the various types of dynamos, and to electric lamps, both arc and incandescent, and to their method of connection in series, multiple series, parallel, etc. We can heartily commend the book to beginners.

Handbuch der Elektrotechnik. By Dr. Erasmus Kittler. *Stuttgart*, Ferdinand Enke, 3 vols., Vol. 1. 2nd Edition. 1,007 pages. 674 Illustrations. 6½x10 in. Price, $5.00.

Since the first edition of Dr. Kittler's work appeared, many changes have occurred in and much light has been thrown on, matters which were obscure at that time; and, as a result, we note many changes which go far towards bringing the work before us well up to date.

The volume begins with a thorough discussion of magnetism and induction with special reference to their application in the construction of dynamo-electric machinery. This is followed by a description of electrical measuring instruments, and of methods of measurement most generally employed in the testing of dynamo-electric machinery. There is added here an excellent chapter on dynamometry, in which the various types of transmission and absorption dynamotors are fully described.

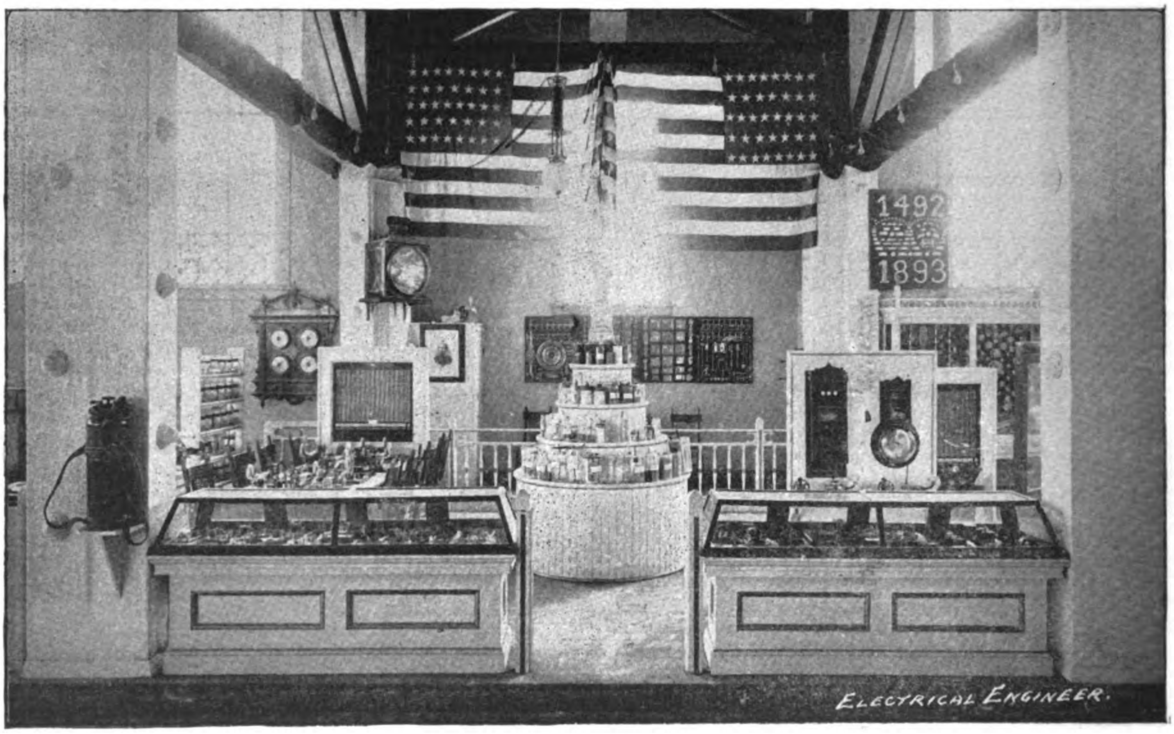
For those who desire to obtain a thorough knowledge of the construction of a large number of modern dynamo-electric machines together with a complete discussion of their relative advantages, we know of no publication more exhaustive; the author has evidently spared no pains to make this part of his work as complete as possible; no detail, however small, seems to have escaped his notice.

Among the most valuable features of the work are the numerous foot notes, which refer the reader to original communications on the points touched. The engravings throughout the work are of the highest excellence, and the get up of the work as a whole reflects the greatest credit on both the author and the publisher.

ELECTRIC HEATING.[1]

BY CARL K. MAC FADDEN.

It has been shown that the cost of operating electric heaters is about on a par with that of a coal stove. Experience in cold climates shows that from 1,200 to 1,500 watts will keep a 16-foot car warm in all weather, and as the electric heaters require no attention, their cost of maintenance is simply the cost of current. Moreover they take up no valuable room in a car, can never burn the clothing of passengers, and can be instantly turned on or off when a sudden cold wave demands or the weather is unseasonably warm.



The E. S. Greeley & Co.'s Exhibit at the World's Fair. (See Page 551.)

The total cost of one net h. p. at the engine on a plant with an average output of 500 electrical h. p. is about $\frac{8}{10}$ of a cent per hour. The cost of an electrical horse-power hour will be found in this same plant to be about one cent. It will be seen from these figures that the total cost of operating electric heaters will be in the neighborhood of two cents per h. p. hour.

The author believes that it is just as fair to both sides of the question to assume that the fireman and engineer will not be called on for nearly as much additional work to furnish current for electric heaters as the street car conductor and other helpers whose time is wholly or partly taken up in attending to coal stoves. In one road which has come under his notice, a man is paid $1.50 a day to take care of stoves on 14 cars. This man has no other work to do, with the exception of oiling a few switches near his work. The man works 12 hours a day, and the cars run 20 hours. We may assume that there is at least from 10 to 15 cents a day spent in labor in tending these stoves, the conductor's time not being included. The cost of coal in such a stove will be in the neighborhood of 20 cents when operating 20 hours a day, with coal at $3 per ton.

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[1] Abstract of a Paper presented at the Chicago Electric Club, May 22, 1893.

MISCELLANEOUS.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.[1]—II.

BY NIKOLA TESLA.

ON PHENOMENA PRODUCED BY ELECTROSTATIC FORCE.

The first class of effects I intend to show you are effects produced by electrostatic force. It is the force which governs the motion of the atoms, which causes them to collide and develop the life-sustaining energy of heat and light, and which causes them to aggregate in an infinite variety of ways, according to Nature's fanciful designs, and to form all these wondrous structures we perceive around us; it is, in fact, if our present views be true, the most important force for us to consider in Nature. As the term *electrostatic* might imply a steady electric condition, it should be remarked, that in these experiments the force is not constant, but varies at a rate which may be considered moderate, about one million times a second, or thereabouts. This enables me to produce many effects which are not producible with an unvarying force.

When two conducting bodies are insulated and electrified, we say that an electrostatic force is acting between them. This force manifests itself in attractions, repulsions and stresses in the bodies and space or medium without. So great may be the strain exerted in the air, or whatever separates the two conducting bodies, that it may break down, and we observe sparks or bundles of light or streamers, as they are called. These streamers form abundantly when the force through the air is rapidly varying. I will illustrate this action of electrostatic force in a novel experiment in which I will employ the induction coil before referred to. The coil is contained in a trough filled with oil, and placed under the table. The two ends of the secondary wire pass through the two thick columns of hard rubber, which protrude to some height above the table. It is necessary to insulate the ends or terminals of the secondary heavily with hard rubber, because even dry wood is by far too poor an insulator for these currents of enormous potential differences. On one of the terminals of the coil, I have placed a large sphere of sheet brass, which is connected to a larger insulated brass plate, in order to enable me to perform the experiments under conditions, which, as you will see, are more suitable for this experiment. I now set the coil to work and approach the free terminal with a metallic object held in my hand, this simply to avoid burns. As I approach the metallic object to a distance of eight or ten inches, a torrent of furious sparks breaks forth from the end of the secondary wire, which passes through the rubber column. The sparks cease when the metal in my hand touches the wire. My arm is now traversed by a powerful electric current, vibrating at about the rate of one million times a second. All around me the electrostatic force makes itself felt, and the air molecules and particles of dust flying about are acted upon and are hammering violently against my body. So great is this agitation of the particles, that when the lights are turned out you may see streams of feeble light appear on some parts of my body. When such a streamer breaks out on any part of the body, it produces a sensation like the pricking of a needle. Were the potentials sufficiently high and the frequency of the vibration rather low, the skin would probably be ruptured under the tremendous strain, and the blood would rush out with great force in the form of fine spray or jet so thin as to be invisible, just as oil will when placed on the positive terminal of a Holtz machine. This breaking through of the skin though it may seem impossible at first, would perhaps occur, by reason of the tissues under the skin being incomparably better conducting. This, at least, appears plausible, judging from some observations.

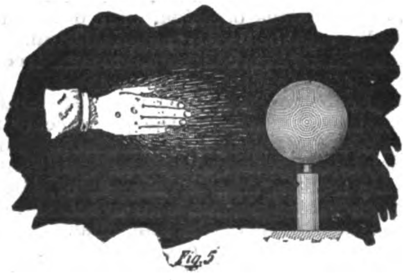

FIG. 5.—ILLUSTRATING THE EFFECT OF VARYING ELECTROSTATIC FORCE WITH A TRANSFORMER OF 200,000 VOLTS PRESSURE.

I can make these streams of light visible to all, by touching with the metallic object one of the terminals as before, and approaching my free hand to the brass sphere, which is connected to the second terminal of the coil. As the hand is approached, the air between it and the sphere, or in the immediate neigborhood, is more violently agitated and you see streams of light now break forth from my finger tips and from the whole hand (Fig. 5). Were I to approach the hand closer, powerful sparks would jump from the brass sphere to my hand, which might be injurious. The streamers offer no particular inconvenience, except that in the ends of the finger tips a burning sensation is felt. They should not be confounded with those produced by an influence machine because in many respects they behave differently. I have attached the brass sphere and plate to one of the terminals in order to prevent the formation of visible streamers on that terminal, also in order to prevent sparks from jumping at a considerable distance. Besides, the attachment is favorable for the working of the coil.

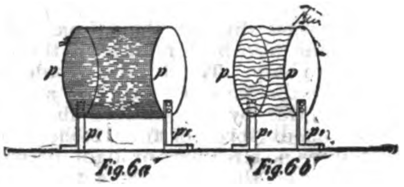

FIG. 6a. } ILLUSTRATING THE EFFECTS OF RAPIDLY VARYING, AND
FIG. 6b. } STEADY, ELECTROSTATIC FORCE.

The streams of light which you have observed issuing from my hand are due to a potential of about 200,000 volts, alternating in rather irregular intervals, something like a million times a second. A vibration of the same amplitude, but four times as fast, to maintain which over 3,000,000 volts would be required, would be more than sufficient to envelop my body in a complete sheet of flame. But this flame would not burn me up; quite contrarily, the probability is that I would not be injured in the least. Yet a hundredth part of that energy, otherwise directed, would be amply sufficient to kill a person.

The amount of energy which may thus be passed into the body of a person depends on the frequency and potential of the currents, and by making both of these very great, a vast amount of energy may be passed into the body without causing any discomfort, except perhaps, in the arm, which is traversed by a true conduction current. The reason why no pain in the body is felt, and no injurious effect noted, is that everywhere, if a current be imagined to flow through the body, the direction of its flow would be at right angles to the surface; hence the body of the experimenter offers an enormous section to the current, and the density is very small, with the exception of the arm perhaps, where the density may be considerable. But if only a small fraction of that energy would be applied in such a way that a current would traverse the body in the same manner as a low frequency current, a shock would be received which might be fatal. A direct or low frequency alternating current is fatal I think, principally because its distribution through the body is not uniform, as it must divide itself in minute streamlets of great density, whereby some organs are vitally injured. That such a process occurs I have not the least doubt, though no evidence might apparently exist, or be found upon examination. The surest to injure and destroy life, is a continuous current, but the most painful is an alternating current of very low frequency. The expression of these views, which are the result of long continued experiment and observation, both with steady and varying currents, is elicited by the interest which is at present taken in this subject, and by the manifestly erroneous ideas which are daily propounded in journals, on this subject.

I may illustrate an effect of the electrostatic force by another striking experiment, but before, I must call your attention to one or two facts. I have said before, that when the medium between two oppositely electrified bodies is strained beyond a certain limit it gives way and, stated in popular language, the opposite electric charges unite and neutralize each other. This breaking down of the medium occurs principally when the force acting between the bodies is steady, or varies at a moderate rate. Were the variation sufficiently rapid, such a destructive break would not occur, no matter how great the force, for all the energy would be spent in radiation, convection and mechanical and chemical action. Thus the *spark* length, or greatest distance through which a *spark* will jump between the electrified bodies is the smaller, the greater the variation or time rate of change. But this rule may be taken to be true only in a general way, when comparing rates which are widely different.

I will show you by an experiment the difference in the effect produced by a rapidly varying and a steady or moderately varying force. I have here two large circular brass plates *pp*, (Fig. 6*a* and Fig. 6*b*), supported on movable insulating stands on the table, connected to the ends of the secondary of a coil similar to the one used before. I place the plates ten or twelve inches apart and set the coil to work. You see the whole space between the plates, nearly two cubic feet, filled with uniform light, Fig. 6*a*. This light is due to the streamers you have seen in the first experiment, which are now much more intense. I have already pointed out the importance of these streamers in commercial apparatus and their still greater importance in some purely scientific investigations. Often they are too weak to be visible, but they always exist, consuming energy and modifying the action of the apparatus. When intense, as they are at present, they produce ozone in great quantity, and also, as Professor Crookes has pointed out, nitrous acid. So quick is the chemical action, that if a coil such as this one, is worked for a very long time it will make the atmosphere of a small room unbearable, for the eyes and throat are attacked. But when moderately produced, the streamers refresh the atmosphere wonderfully, like a thunderstorm, and exercise unquestionably a beneficial effect.

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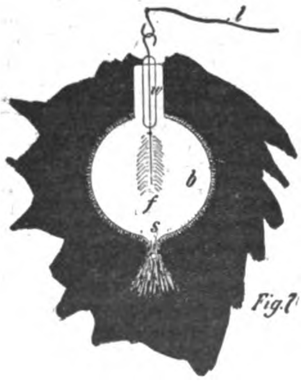
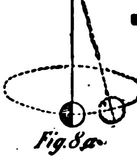
[1] A lecture delivered before the Franklin Institute, at Philadelphia, Feb. 24, 1893, and before the National Electric Light Association, at St. Louis, Mo., March 1, 1893.

In this experiment the force acting between the plates changes in intensity and direction at a very rapid rate. I will now make the rate of change per unit time much smaller. This I effect by rendering the discharges through the primary of the induction coil less frequent, and also by diminishing the rapidity of the vibration in the secondary. The former result is conveniently secured by lowering the E. M. F. over the air gap in the primary circuit, the latter by approaching the two brass plates to a distance of about three or four inches. When the coil is set to work you see no streamers or light between the plates, yet the medium between them is under a tremendous strain. I still further augment the strain by raising the E. M. F. in the primary circuit, and soon you see the air give way and the hall is illuminated by a shower of brilliant and noisy sparks, 6*b*. These sparks could be produced also with unvarying force; they have been for many years a familiar phenomenon, though they were usually obtained from entirely different apparatus. In describing these two phenomena so radically different in appearance, I have advisedly spoken of a "force" acting between the plates. It would be in accordance with accepted views to say, that there was an "alternating E. M. F." acting between the plates. This term is quite proper and applicable in all cases where there is evidence of at least a possibility of an essential inter-dependence of the electric state of the plates, or electric action in their neighborhood. But if the plates were removed to an infinite distance, or if at a finite distance, there is no probability or necessity whatever for such dependence. I prefer to use the term "electrostatic force," and to say that such a force is acting around each plate or electrified insulated body in general. There is an inconvenience in using this expression as the term incidentally means a steady electric condition; but a proper nomenclature will eventually settle this difficulty.

I now return to the experiment to which I have already alluded, and with which I desire to illustrate a striking effect produced by a rapidly varying electrostatic force. I attach to the end of the wire, *l* (Fig. 7), which is in connection with one of the terminals of the secondary of the induction coil, an exhausted bulb *b*. This bulb contains a thin carbon filament *f*, which is fastened to a platinum wire *w*, sealed in the glass and leading outside of the bulb, where it connects to the wire *l*. The bulb may be exhausted to any degree attainable with ordinary apparatus. Just a moment before, you have witnessed the breaking down of the air between the charged brass plates. You know that a plate of glass, or any other insulating material, would break down in like manner. Had I therefore a metallic coating attached to the outside of the bulb, or placed near the same, and were this coating connected to the other terminal of the coil, you would be prepared to see the glass give way if the strain were sufficiently increased. Even were the coating not connected to the other terminal, but to an insulated plate, still, if you have followed recent developments, you would naturally expect a rupture of the glass.





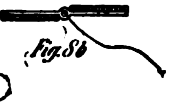
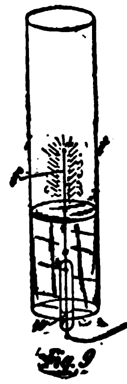


FIG. 7.—BREAKING A BULB ON OPEN CIRCUIT.

FIG. 8*a*. } MECHANICAL MOTIONS PRODUCED BY VARYING ELECTROSTATIC FORCE IN A GASEOUS MEDIUM.
FIG. 8*b*. }

But it will certainly surprise you to note that under the action of the varying electrostatic force, the glass gives way when all other bodies are removed from the bulb. In fact, all the surrounding bodies we perceive might be removed to an infinite distance without affecting the result in the slightest. When the coil is set to work, the glass is invariably broken through at the seal, or other narrow channel, and the vacuum is quickly impaired. Such a damaging break would not occur with a steady force, even if the same were many times greater. The break is due to the agitation of the molecules of the gas within the bulb, and outside of the same. This agitation, which is generally most violent in the narrow pointed channel near the seal, causes a heating and rupture of the glass. This rupture, would, however, not occur, not even with a varying force, if the medium filling the inside of the bulb, and that surrounding it were perfectly homogeneous. The break occurs much quicker if the top of the bulb is drawn out into a fine fibre. In bulbs used with these coils such narrow, pointed channels must therefore be avoided.



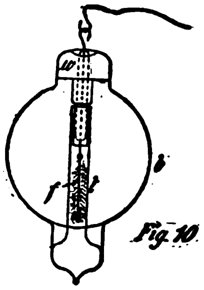


FIG. 9.—SHOWING THE EFFECT OF THE AIR.

FIG. 10.—SHOWING THE INFLUENCE OF THE CONDUCTIVITY OF THE MEDIUM UPON ELECTROSTATIC ACTIONS THROUGH MEASURABLE DISTANCE.

When a conducting body is immersed in air, or similar insulating medium, consisting of, or containing, small freely movable particles capable of being electrified, and when the electrification of the body is made to undergo a very rapid change—which is equivalent to saying that the electrostatic force acting around the body is varying in intensity,—the small particles are attracted and repelled, and their violent impacts against the body may cause a mechanical motion of the latter. Phenomena of this kind are noteworthy in as much as they have not been observed before with apparatus such as has been commonly in use. If a very light conducting sphere be suspended on an exceedingly fine wire, and charged to a steady potential, however high, the sphere will remain at rest. Even if the potential would be rapidly varying, provided that the small particles of matter, molecules or atoms, are evenly distributed, no motion of the sphere should result. But if one side of the conducting sphere is covered with a thick insulating layer, the impacts of the particles will cause the sphere to move about, generally in irregular curves, Fig. 8*a*. In like manner, as I have shown on a previous occasion, a fan of metal sheet, Fig. 8*b*, covered partially with insulating material as indicated, and placed upon the terminal of the coil so as to turn freely in it, is spun around.

All these phenomena you have witnessed and others which will be shown later, are due to the presence of a medium like air, and would not occur in a continuous medium. The action of the air may be illustrated still better by the following experiment. I take a glass tube *t*, Fig. 9, of about an inch in diameter, which has a platinum wire *w* sealed in the lower end, and to which is attached a thin lamp filament *f*. I connect the wire with the terminal of the coil and set the coil to work. The platinum wire is now electrified positively and negatively in rapid succession and the wire and air inside of the tube is rapidly heated by the impacts of the particles, which may be so violent as to render the filament incandescent. But if I pour oil in the tube, just as soon as the wire is covered with the oil, all action apparently ceases and there is no marked evidence of heating. The reason of this is that the oil is a practically continous medium. The displacements in such a continous medium are, with these frequencies, to all appearance incomparably smaller than in air, hence the work performed in such a medium is insignificant. But oil would behave very differently with frequencies many times as great, for even though the displacements be small, if the frequency were much greater considerable work might be performed in the oil.

The electrostatic attractions and repulsions between bodies of measurable dimensions are, of all the manifestations of this force, the first so-called *electrical* phenomena noted. But though they have been known to us for many centuries, the precise nature of the mechanism concerned in these actions is still unknown to us, and has not been even quite satisfactorily explained. What kind of mechanism must that be? We cannot help wondering when we observe two magnets attracting and repelling each other with a force of hundreds of pounds with apparently nothing between them. We have in our commercial dynamos magnets capable of sustaining in mid-air tons of weight. But what are even these forces acting between magnets when compared with the tremendous attractions and repulsions produced by electrostatic force, to which there is apparently no limit as to intensity. In lightning discharges bodies are often charged to so high a potential that they are thrown away with inconceivable force and torn asunder or shattered into fragments. Still even such effects cannot compare with the attractions and repulsions which exist between charged molecules or atoms, and which are sufficient to project them with speeds of many kilometres a second so that under their violent impact bodies are rendered highly incandescent and are volatilized. It is of special interest for the thinker who inquires into the nature of these forces to note, that whereas the actions between individual molecules or atoms occur seemingly under any condition, the attractions and repulsions of bodies of measurable dimensions imply a medium possessing insulating properties. So, if air, either by being rarefied or heated, is rendered more or less conducting, these actions between two electrified bodies practically cease, while the actions between the individual atoms continue to manifest themselves.

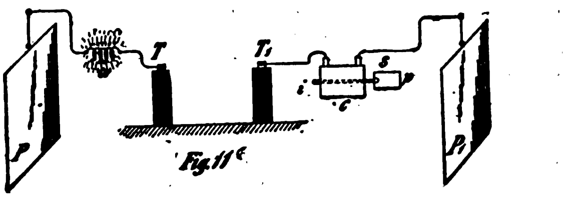


FIG. 11.—SHOWING EFFECTS OF CURRENTS FLOWING THROUGH OPEN CIRCUITS.

An experiment may serve as an illustration and as a means of bringing out other features of interest. Some time ago I showed that a lamp filament or wire mounted in a bulb and connected to one of the terminals of a high tension secondary coil is set spinning, the top of the filament generally describing a circle. This vibration was very energetic when the air in the bulb was at ordinary pressure and became less energetic when the air in the bulb was strongly compressed. It ceased altogether when the air was exhausted so as to become comparatively good conducting. I found at that time that no vibration took place when the bulb was very highly exhausted. But I conjectured that the vibration which I ascribed to the electrostatic action between the walls of the bulb and the filament should take place also in a highly exhausted bulb. To test this under conditions which were more favorable, a bulb like the one in Fig. 10, was constructed. It comprised a globe *b* in the neck of which was sealed a platinum wire *w* carrying at thin lamp filament *f*. In the lower part of the globe a tube *t* was sealed so as to surround the filament. The exhaustion was carried as far as it was practicable with the apparatus employed.

This bulb verified my expectation, for the filament was set spinning when the current was turned on, and became incandescent. It also showed another interesting feature, bearing upon the preceding remarks, namely, when the filament had been kept incandescent some time the narrow tube and the space inside was brought to an elevated temperature, and as the gas in the tube then became conducting, the eletrostatic attraction between the glass and the filament became very weak or ceased and the filament came to rest. When it came to rest it would glow far more intensely. This was probably due to its assuming the position in the centre of the tube where the molecular bombardment was most intense, and also partly to the fact that the individual impacts were more violent and that no part of the supplied energy was converted into mechanical movement. Since, in accordance with accepted views, in this experiment the incandescence must be attributed to the impacts of the particles, molecules or atoms in the heated space, these particles must therefore, in order to explain such action, be assumed to behave as independent carriers of electric charges immersed in an insulating medium; yet there is no attractive force between the glass tube and the filament because the space in the tube is, as a whole, conducting.

It is of some interest to observe in this connection that whereas the attraction between two electrified bodies may cease owing to the impairing of the insulating power of the medium in which they are immersed, the repulsion between the bodies may still be observed. This may be explained in a plausible way. When the bodies are placed at some distance in a poorly conducting medium, such as slightly warmed or rarefied air, and are suddenly electrified, opposite electric charges being imparted to them, these charges equalize more or less by leakage through the air. But if the bodies are similarly electrified, there is less opportunity afforded for such dissipation, hence the repulsion observed in such case is greater than the attraction. Repulsive actions in a gaseous medium are however, as Prof. Crookes has shown, enhanced by molecular bombardment.

ON CURRENT OR DYNAMIC ELECTRICITY PHENOMENA.

So far, I have considered principally effects produced by a varying electrostatic force in an insulating medium, such as air. When such a force is acting upon a conducting body of measurable dimensions, it causes within the same, or on its surface, displacements of the electricity and gives rise to electric currents, and these produce another kind of phenomena, some of which I shall presently endeavor to illustrate. In presenting this second class of electrical effects, I will avail myself principally of such as are producible without any return circuit, hoping to interest you the more by presenting these phenomena in a more or less novel aspect.

It has been for a long time customary, owing to the limited experience with vibratory currents, to consider an electric current as something circulating in a closed conducting path. It was astonishing at first to realize that a current may flow through the conducting path even if the latter be interrupted, and it was still more surprising to learn, that sometimes it may be even easier to make a current flow under such conditions than through a closed path. But that old idea is gradually disappearing, even among practical men, and will soon be entirely forgotten.

If I connect an insulated metal plate P, Fig. 11, to one of the terminals T of the induction coil by means of a wire, though this plate be very well insulated, a current passes through the wire when the coil is set to work. First I wish to give you evidence that there *is* a current passing through the connecting wire. An obvious way of demonstrating this is to insert between the terminal of the coil and the insulated plate a very thin platinum or german silver wire *w* and bring the latter to incandescence or fusion by the current. This requires a rather large plate or else current impulses of very high potential and frequency. Another way is to take a coil C, Fig. 11, containing many turns of thin insulated wire and to insert the same in the path of the current to the plate. When I connect one of the ends of the coil to the wire leading to another insulated plate P, and its other end to the terminal T_1 of the induction coil, and set the latter to work, a current passes through the inserted coil C and the existence of the current may be made manifest in various ways. For instance, I insert an iron core *i* within the coil. The current being one of very high frequency, if it be of some strength, will soon bring the iron core to a noticeably higher temperature, as the hysteresis and current losses are great with such high frequencies. One might take a core of some size, laminated or not, it would matter little; but ordinary iron wire $\frac{1}{16}$th or $\frac{1}{8}$th of an inch thick is suitable for the purpose. While the induction coil is working a current traverses the inserted coil and only a few moments are sufficient to bring the iron wire *i* to an elevated temperature sufficient to soften the sealing-wax *s*, and cause a paper washer *p* fastened by it to the iron wire to fall off. But with the apparatus such as I have here other, much more interesting, demonstrations of this kind can be made. I have a secondary S, Fig. 12, of coarse wire, wound upon a coil similar to the first. In the preceding experiment the current through the coil C, Fig. 11, was very small, but there being many turns a strong heating effect was, nevertheless, produced in the iron wire. Had I passed that current through a conductor in order to show the heating of the latter, the current might have been too small to produce the effect desired. But with this coil provided with a secondary winding, I can now transform the feeble current of high tension which passes through the primary P into a strong secondary current of low tension, and this current will quite certainly do what I expect. In a small glass tube (*t*, Fig. 12), I have enclosed a coiled platinum wire, *w*, this merely in order to protect the wire. On each end of the glass tube is sealed a terminal of stout wire to which one of the ends of the platinum wire *w*, is connected. I join the terminals of the secondary coil to these terminals and insert the primary *p*, between the insulated plate P_1 and the terminal T_1 of the induction coil as before. The latter being set to work, instantly the platinum wire *w* is rendered incandescent and can be fused even if it be very thick.

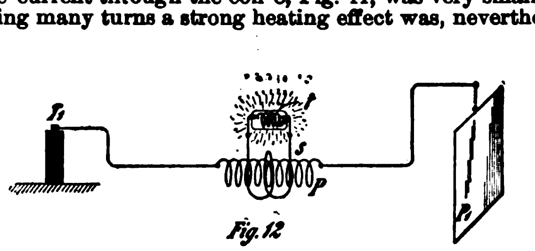


FIG. 12.—CONVERSION ON OPEN CIRCUIT WITH COIL AND INSULATED PLATE.

Instead of the platinum wire I now take an ordinary 50-volt 16 c. p. lamp. When I set the induction coil in operation the lamp filament is brought to high incandescence. It is, however, not necessary to use the insulated plate, for the lamp (*l*, Fig. 13) is rendered incandescent even if the plate P_1 be disconnected. The secondary may also be connected to the primary as indicated by

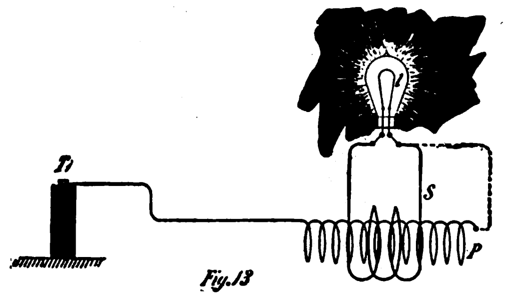
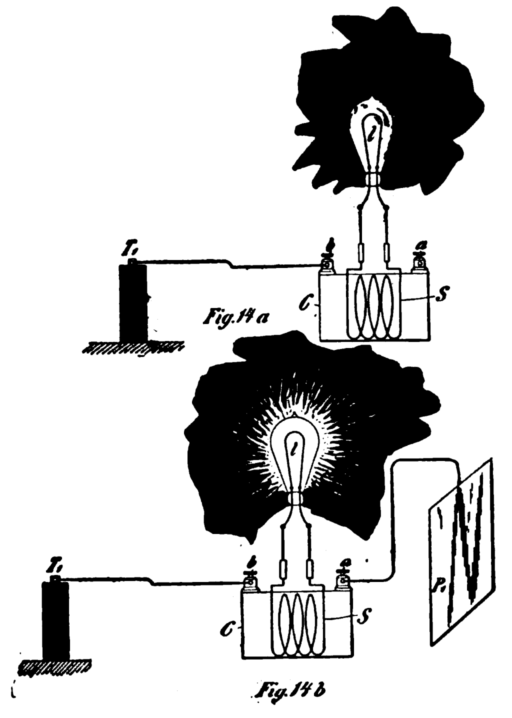


FIG. 13.—CONVERSION ON OPEN CIRCUIT WITH COIL ALONE.

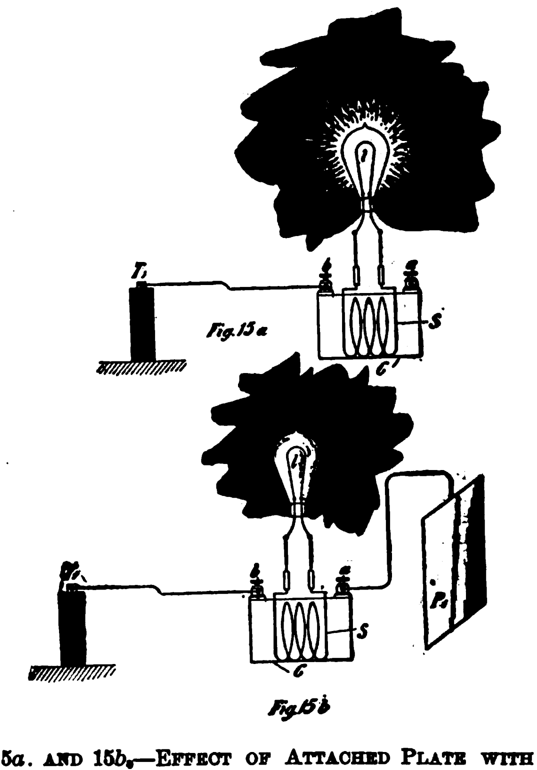
the dotted line in Fig. 13, to do away more or less with the electrostatic induction or to modify the action otherwise.

I may here call attention to a number of interesting observations with the lamp. First, I disconnect one of the terminals of the lamp from the secondary S. When the induction coil plays, a glow is noted which fills the whole bulb. This glow is due to electrostatic induction. It increases when the bulb is grasped with the hand, and the capacity of the experimenter's body thus added to the secondary circuit. The secondary, in effect, is equivalent to a metallic coating, which would be placed near the primary. If the secondary, or its equivalent, the coating, were placed symmetrically to the primary, the electrostatic induction would be nil under ordinary conditions, that is, when a primary return circuit is used, as both halves would neutralize each other. The secondary *is* in fact placed symmetrically to the primary, but the action of both halves of the latter, when only one of its ends is connected to the induction coil, is not exactly equal; hence electrostatic induction takes place, and hence the glow in the bulb. I can nearly equalize the action of both halves of the primary by connecting the other, free end of the same to the insulated plate, as in the preceding experiment. When the plate is connected, the glow disappears. With a smaller plate it would not entirely disappear and then it would contribute to the brightness of the filament when the secondary is closed, by warming the air in the bulb.



FIGS. 14*a*. AND 14*b*.—EFFECT OF ATTACHED PLATE WITH LOW FREQUENCIES.

To demonstrate another interesting feature, I have adjusted the coils used in a certain way. I first connect both the terminals of the lamp to the secondary, one end of the primary being connected to the terminal T_1 of the induction coil and the other to the insulated plate P_1 as before. When the current is turned on, the lamp glows brightly, as shown in Fig. 14*b*, in which C is a fine wire coil and S a coarse wire secondary wound upon it. If the insulated plate P_1 is disconnected, leaving one of the ends *a* of the primary insulated, the filament becomes dark or generally it diminishes in brightness (Fig. 14*a*). Connecting again the plate P_1 and raising the frequency of the current I make the filament quite dark or barely red, Fig. 15*b*. Once more I will disconnect the plate. One will of course infer that when the plate is disconnected, the current through the primary will be weakened, that therefore the E. M. F. will fall in the secondary S, and that the brightness of the lamp will diminish. This might be the case and the result can be secured by an easy adjustment of the coils; also by varying the frequency and potential of the currents. But it is perhaps of greater interest to note, that the lamp increases in brightness when the plate is disconnected (Fig. 15*a*). In this case all the energy the primary receives is now sunk into it, like the charge of a battery in an ocean cable, but most of that energy is recovered through the secondary and used to light the lamp. The current traversing the primary is strongest at the end *b* which is connected to the terminal T_1 of the induction coil, and diminishes in strength towards the remote end *a*. But the dynamic inductive effect exerted upon the secondary S is now greater than before when the suspended plate was connected to the primary. These results might have been produced by a number of causes. For instance, the plate P_1 being connected, the reaction from the coil C may be such as to diminish the potential at the terminal T_1 of the induction coil, and therefore weaken the current through the primary of the coil C. Or the disconnecting of the plate may diminish the capacity effect with relation to the primary of the latter coil to such an extent that the current through it is diminished, though the potential at the terminal T_1 of the induction coil may be the same or even higher. Or the result might have been produced by the change of phase of the primary and secondary currents and consequent reaction. But the chief determining factor is the relation of the self-induction and capacity of coil C and plate P_1 and the frequency of the currents. The greater brightness of the filament in Fig. 15*a*, is however, in part due to the heating of the rarefied gas in the lamp by electrostatic induction, which, as before remarked, is greater when the suspended plate is disconnected.



FIGS. 15*a*. AND 15*b*.—EFFECT OF ATTACHED PLATE WITH HIGH FREQUENCIES.

Still another feature of some interest I may here bring to your attention. When the insulated plate is disconnected and the secondary of the coil opened, by approaching a small object to the secondary, but very small sparks can be drawn from it, showing that the electrostatic induction is small in this case. But upon the secondary being closed upon itself or through the lamp, the filament glowing brightly, strong sparks are obtained from the secondary. The electrostatic induction is now much greater, because the closed secondary determines a greater flow of current through the primary and principally through that half of it which is connected to the induction coil. If now the bulb be grasped with the hand, the capacity of the secondary with reference to the primary is augmented by the experimenter's body and the luminosity of the filament is increased, the incandescence now being due partly to the flow of current through the filament and partly to the molecular bombardment of the rarefied gas in the bulb.

The preceding experiments will have prepared one for the next following results of interest, obtained in the course of these investigations. Since I can pass a current through an insulated wire merely by connecting one of its ends to the source of electrical energy, since I can induce by it another current, magnetize an iron core, and in short, perform all operations, as though a return circuit were used, clearly I can also drive a motor by the aid of only one wire. On a former occasion I have described a simple form of motor comprising a single exciting coil, an iron core and disc. Fig. 16, illustrates a modified way of operating such an alternate current motor by currents induced in a transformer connected to one lead, and several other arrangements of circuits for operating a certain class of alternate motors founded on the action of currents of differing phase. In view of the present state of the art it is thought sufficient to describe these arrangements in a few words only. In the diagram, Fig. 16 II., shows a primary coil P, connected with one of its ends to the line L leading from a high tension transformer terminal T_1. In inductive relation to this primary P is a secondary S of coarse wire in the circuit of which is a coil *c*. The currents induced in the secondary energize the iron core *i*, which is preferably, but not necessarily, subdivided, and set the metal disc *d* in rotation. Such a motor M_2, as diagrammatically shown in Fig. 16 II., has been called a "magnetic lag motor," but this expression may be objected to by those who attribute the rotation of the disc to eddy currents circulating in minute paths when the core *i* is finally subdivided. In order to operate such a motor effectively on the plan indicated, the frequencies should not be too high, not more than four or five thousand, though the rotation is produced even with ten thousand per second, or more.

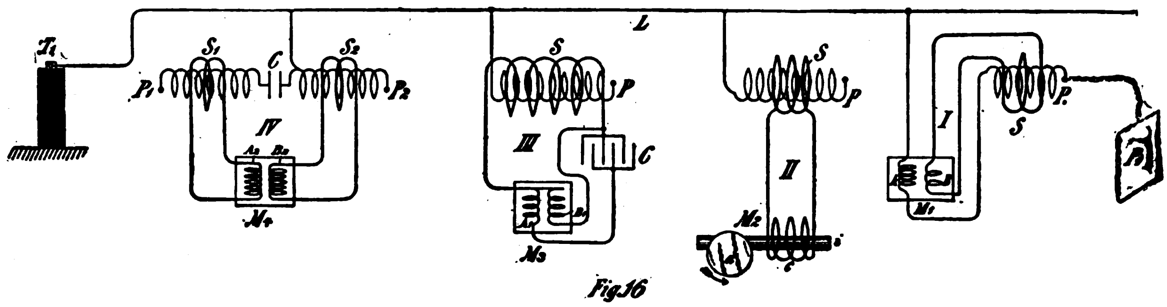


FIG. 16.—WAYS OF OPERATING MOTORS WITH ONLY ONE LEAD.

In Fig. 16 I., a motor M_1, having two energizing circuits, A and B, is diagrammatically indicated. The circuit A is connected to the line L and in series with it is a primary P, which may have its free end connected to an insulated plate P_1, such connection being indicated by the dotted lines. The other motor circuit B is connected to the secondary S which is in inductive relation to the primary P. When the transformer terminal T_1 is alternately electrified, currents traverse the open line L and also circuit A and primary P. The currents through the latter induce secondary currents in the circuit S, which pass through the energizing coil B of the motor. The currents through the secondary S and those through the primary P differ in phase 90 degrees, or nearly so, and are capable of rotating an armature placed in inductive relation to the circuits A and B.

In Fig. 16 III., a similar motor M_3 with two energizing circuits A_1 and B_1 is illustrated. A primary P, connected with one of its ends to the line L has a secondary S, which is preferably wound for a tolerably high E. M. F., and to which the two energizing circuits of the motor are connected, one directly to the ends of the secondary and the other through a condenser C, by the action of which the currents traversing the circuit A_1 and B_1 are made to differ in phase.

In Fig. 16 IV still another arrangement is shown. In this case two primaries P_1 and P_2 are connected to the line L, one through a condenser C of small capacity, and the other directly. The primaries are provided with secondaries S_1 and S_2 which are in series with the energizing circuits A_2 and B_2 and a motor M_4, the condenser C again serving to produce the requisite difference in the phase of the currents traversing the motor circuits. As such phase motors with two or more circuits are now well known in the art, they have been here illustrated diagrammatically. No difficulty whatever is found in operating a motor in the manner indicated or in similar ways, and although such experiments up to this day present only scientific interest, they may at a period not far distant, be carried out with practical objects in view.

It is thought useful to devote here a few remarks to the subject of operating devices of all kinds by means of only one leading wire. It is quite obvious, that when high-frequency currents are made use of, ground connections are—at least when the E. M. F. of the currents is great—better than a return wire. Such ground connections are objectionable with steady or low frequency currents on account of destructive chemical actions of the former and disturbing influences exerted by both on the neighboring circuits; but with high frequencies these actions practically do not exist. Still, even ground connections become superfluous when the E. M. F. is very high, for soon a condition is reached, when the current may be passed more economically through open, than through closed conductors. Remote as might seem an industrial application of such single wire transmission of energy to one not experienced in such lines of experiment, it will not seem so to anyone who for some time has carried on investigations of such nature. Indeed I cannot see why such a plan should not be practicable. Nor should it be thought that for carrying out such a plan currents of very high frequency are expressly required, for just as soon as potentials of say 30,000 volts are used, the single wire transmission may be effected with low frequencies, and experiments have been made by me from which these inferences are made.

When the frequencies are very high it has been found in laboratory practice quite easy to regulate the effects in the manner shown in diagram Fig. 17. Here two primaries P and P are shown, each connected with one of its ends to the line L and with the other end to the condenser plates C and C^1, respectively. Near these are placed other condenser plates C_1 and C^1_1, the former being connected to the line L and the latter to an insulated larger plate P_2. On the primaries are wound secondaries S and S_1 of coarse wire, connected to the devices *m* and *d* respectively. By varying the distances of the condenser plates C and C^1, and C_1 and $C_1{}^1$, the currents through the secondaries S and S_1 are varied in intensity. The curious feature is the great sensitiveness, the slightest change in the distance of the plates producing considerable variations in the intensity or strength of the currents. The sensitiveness may be rendered extreme by making the frequency such, that the primary itself without any plate attached to its free end satisfies, in conjunction with the closed secondary, the condition of resonance. In such condition an extremely small change in the capacity of the free terminal produces great variations. For instance, I have been able to adjust the conditions so that the mere approach of a person to the coil produces a considerable change in the brightness of the lamps attached to the secondary. Such observations and experiments possess of course, at present, chiefly scientific interest, but they may soon become of practical importance.

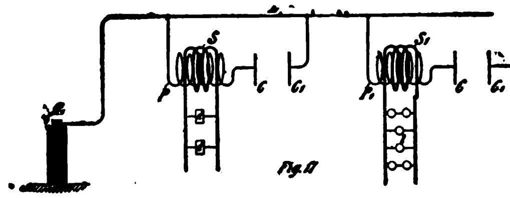


FIG. 17.—SINGLE WIRE CONVERSION AND DISTRIBUTION, WITH SIMPLE MEANS FOR REGULATING THE EFFECTS.

Very high frequencies are of course not practicable with motors on account of the necessity of employing iron cores. But one may use sudden discharges of low frequency and thus obtain certain advantages of high-frequency currents without rendering the iron core entirely incapable of following the changes and without entailing a very great expenditure of energy in the core.

I have found it quite practicable to operate with such low frequency disruptive discharges of condensers, alternating-current motors. A certain class of such motors which I advanced a few years ago, which contain closed secondary circuits, will rotate quite vigorously when the discharges are directed through the exciting coils. One reason that such a motor operates so well with these discharges is that the difference of phase between the primary and secondary currents is 90 degrees, which is generally not the case with harmonically rising and falling currents of low frequency. It might not be without interest to show an experiment with a simple motor of this kind, inasmuch as it is commonly thought that disruptive discharges are unsuitable for such purposes. The motor is illustrated in Fig. 18. It comprises a rather large iron core i with slots on the top into which are embedded thick copper washers c c. In proximity to the core is a freely-movable metal disc D. The core is provided with a primary exciting coil C the ends a and b of which are connected to the terminals of the secondary S of an ordinary transformer, the primary P of the latter being connected to an alternating distribution circuit or generator G of low or moderate frequency. The terminals of the secondary S are attached to a condenser C which discharges through an air gap d d which may be placed in series or shunt to the coil C. When the conditions are properly chosen the disc D rotates with considerable effort and the iron core i does not get very perceptibly hot. With currents from a high-frequency alternator, on the contrary, the core gets rapidly hot and the disc rotates with a much smaller effort. To perform the experiment properly it should be first ascertained that the disc D is not set in rotation when the discharge is not occurring at d d. It is preferable to use a large iron core and a condenser of large capacity so as to bring the superimposed quicker oscillation to a very low pitch or to do away with it entirely. By observing certain elementary rules I have also found it practicable to operate ordinary series or shunt direct-current motors with such disruptive discharges, and this can be done with or without a return wire.

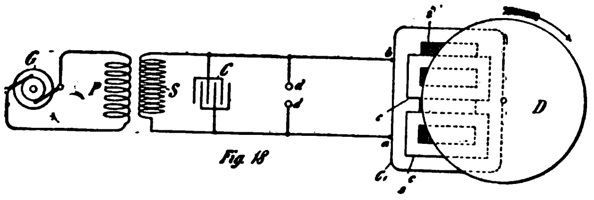


FIG. 18.—OPERATING A MOTOR BY DISRUPTIVE DISCHARGES.

IMPEDANCE PHENOMENA.

Among the various current phenomena observed perhaps the most interesting are those of impedance presented by conductors to currents varying at a rapid rate. In my first paper before the American Institute of Electrical Engineers, I have described a few striking observations of this kind. Thus I showed that when such currents or sudden discharges are passed through a thick metal bar there may be points at the bar only a few inches apart, which have a sufficient potential difference between them to maintain at bright incandescence an ordinary filament lamp. I have also described the curious behavior of rarefied gas surrounding a conductor due to such sudden rushes of current. These phenomena have been since more carefully studied and one or two novel experiments of this kind are deemed of sufficient interest to be described here.

With reference to Fig. 19a, B and B_1 are very stout copper bars connected at their lower ends to plates C and C_1 respectively, of a condenser, the opposite plates of the latter being connected to the terminals of the secondary S of a high-tension transformer, the primary P of which is supplied with alternating currents from an ordinary low-frequency dynamo G or distribution circuit. The condenser discharges through an adjustable gap d d as usual. By establishing a rapid vibration it was found quite easy to perform the following curious experiment. The bars B and B_1 were joined at the top by a low-voltage lamp l_3; a little lower, was placed by means of clamps c c, a 50-volt lamp l_2 and still lower another 100-volt lamp l_1, and finally at a certain distance below the latter lamp an exhausted tube T. By carefully determining the positions of these devices it was found practicable to maintain them all at their proper illuminating power. Yet they were all connected in multiple arc to the two stout copper bars and required widely different pressures. This experiment requires of course some time for adjustment but is quite easily performed.

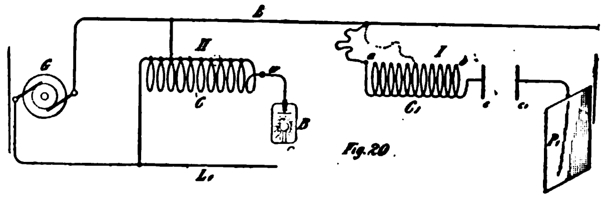
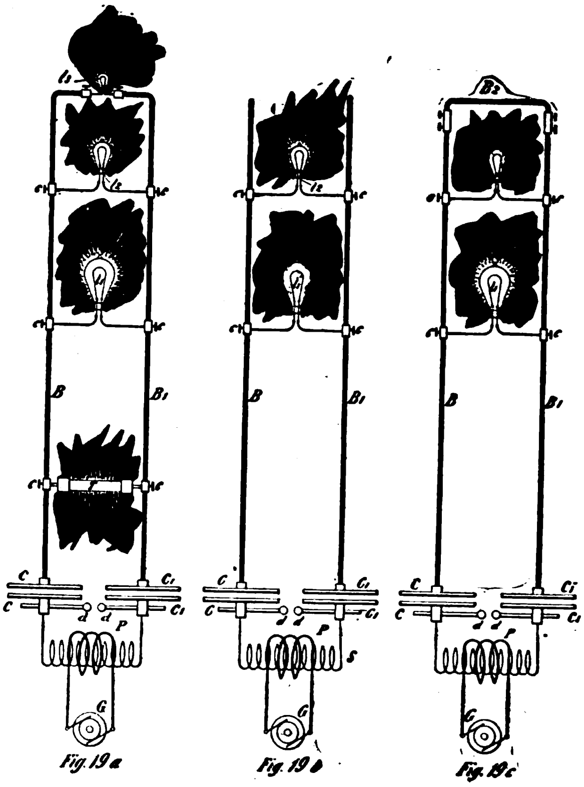


FIG. 20.—PLAN FOLLOWED IN OBSERVING THE EFFECTS OF RESONANCE.

In Figs. 19b and 19c, two other experiments are illustrated which, unlike the previous experiment, do not require very careful adjustments. In Fig. 19b, two lamps l_1 and l_2, the former a 100-volt and the latter a 50-volt are placed in certain positions as indicated, the 100-volt lamp being below the 50-volt lamp. When the arc is playing at d d and the sudden discharges are passed through the bars B B_1 the 50-volt lamp will as a rule burn brightly, or at least this result is easily secured, while the 100-volt lamp will burn very low or remain quite dark, Fig. 19b. Now the bars B B_1 may be joined at the top by a thick cross-bar B_2, and it is quite easy to maintain the 100-volt lamp at full candle-power while the 50-volt lamp remains dark, Fig. 19c. These results, as I have pointed out previously, should not be considered to be due exactly to frequency but rather to the time rate of change which may be great even with low frequencies. A great many other results of the same kind equally interesting, especially to those who are only used to manipulate steady currents, may be obtained and they afford precious clues in investigating the nature of electric currents.



FIGS. 19a, 19b AND 19c.—IMPEDANCE PHENOMENA.

In the preceding experiments I have already had occasion to show some light phenomena and it would now be proper to study these in particular; but to make this investigation more complete I think it necessary to make first a few remarks on the subject of electrical resonance which has to be always observed in carrying out these experiments.

MADE TO BELIEVE IT WAS AN EVIL SPIRIT.

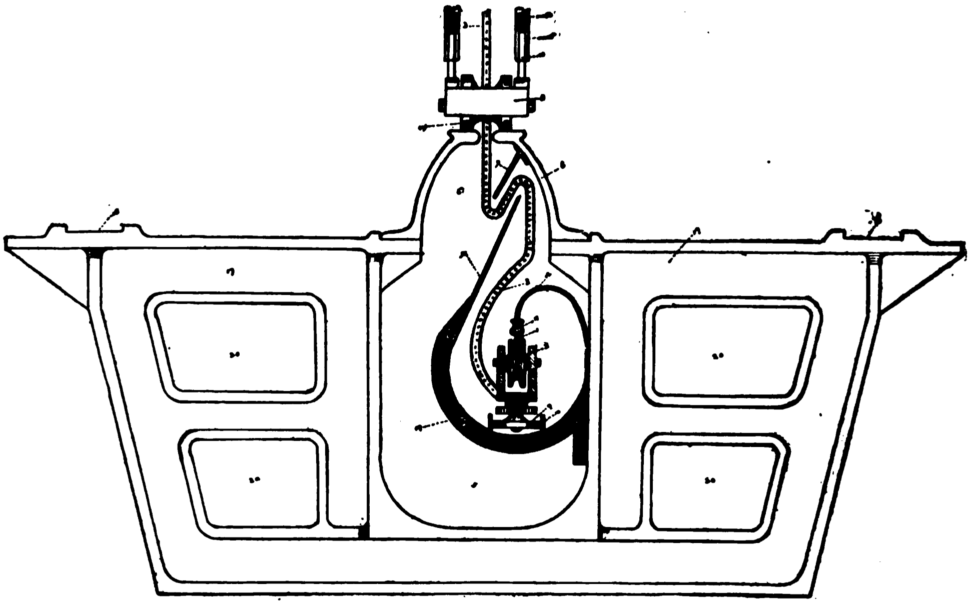
"THE Bolivian Government," said Amos J. Thomas, "recently attempted to establish a telephone line between Lapas and Lake Titicaca, 45 miles apart. It was torn down and destroyed so frequently by the Indians that the Government was compelled to abandon it. The electric light plant in Lapas was preserved by adopting an ingenious method of overawing the natives. After the plant had been in operation but a few nights it happened that there was an eclipse of the moon. The superstitious Indians believed that the electric light was absorbing or swallowing the moon. They gathered in a large body at one quarter of the town and moved upon the plant to destroy it. It was saved only by the intervention of a large body of troops. The Government the next day selected several representative Indians, took them to the power house, shocked them severely, then took them out along the line and shocked them again with the wires and informed them that the electric light was an evil spirit and that they had better leave it alone. Since then they have had no trouble on that score."—*Washington Star.*

ELECTRIC RAILWAY DEPARTMENT.

THE GRIFFEN ELECTRIC RAILWAY CONDUIT.

THE great desiderata in any railway conduit system are high insulation, good drainage and the protection of the conductor from matter falling down through the slot. To meet these conditions the Griffen conduit system illustrated in the accompanying engraving has been designed. The yoke construction, similar to that employed in cable traction has been adopted for the support of the conduit and the slot rails. An overlapping cover protects the chamber in which the conductor is placed, from floods until the water rises to within six inches of the street level. Again, the form of the trolley arm is such that it seems impossible for rain or dirt to drip into or enter the conductor tube. All extraneous matter of this kind is diverted by the tube cover and gathered at the bottom of the large chamber which is in direct connection with the sewer.

The conductor is amply insulated by air by its central position in the trolley chamber. The lateral and perpendicular movements of the trolley arm are provided for by the guide carriage and the point of contact of the trolley wheel on the trolley may be at the top or at the bottom. The system is being exploited by the Electrical Conduit Traction Equipment Company, of this city.



GRIFFEN ELECTRIC RAILWAY CONDUIT.

THE STATUS OF THE BOSTON WEST END ROAD.

WEST END STREET RAILWAY earnings are reported as follows:

April.	Electric.	Horse.	Total.
Gross	$450,932	$87,240	$538,172
Expenses	276,304	87,173	363,477
Net	$174,628	$67	$174,695

The poor showing of the horse department in April is said to be due to the fact that the company had to support some fifteen hundred surplus horses, pending the disposal of the same by auction, which required about six weeks, including April. The management has gone over the estimates of outlay and income this calendar year to see how near the earlier estimates are likely to approximate the actual figures, and it finds that the year is likely to close with all extraordinary construction betterments completed at a cost of less than $500,000 above the original estimate. The company's floating debt is about $900,000. It matures all along until into October. The company will receive from the bond subscription in October and December about $950,000, or enough to cancel the present floating debt. The July dividends may require temporary borrowing, but the season of large earnings is here, and if reasonable expectations are realized the company should earn eight per cent. on the preferred and nine on the common, finish contemplated betterments and go into 1894 with a floating debt not exceeding $500,000, which is a small item for a property of this size.

WESTINGHOUSE CARS FOR OTTAWA, CANADA.

TWENTY cars are being turned out by the Ahearn & Soper Car Works, Ottawa, Canada, for the Montreal Street Railway Company. They will be equipped with Westinghouse motors and delivered ready for operation on the tracks.

A SIEMENS & HALSKE RAILWAY CONTRACT.

A DISPATCH from Hamilton, Ont., of May 29, says: The Hamilton Radial Electric Railway Company has decided to award the contract for wiring and for electric machinery and the plant necessary for conveying power from Niagara Falls to Hamilton to the Siemens & Halske Company. The work will be begun immediately. The cost of bringing the power to Hamilton is estimated at $200,000, and the total cost of all machinery, plant, and labor for the power required by the company will be $1,200,000, or $6 per horse-power.

ELECTRIC PRODUCTION OF ANILINE.

MM. COBLENTZ FRÈRES, of Paris, have developed a method of producing aniline from nitro-benzine electrically, which is described in the *Revue de Chimie Industrielle* and in the *Moniteur Industrielle* (May 9). A cylinder of double thickness is used, two metres long, the liquid in which is agitated by a screw. Pieces of zinc are arranged inside, and a solution of sulphate of zinc is first introduced and allowed to act, the copper being finely deposited on the zinc. The solution is emptied and a mixture of two-thirds nitro-benzine and one-third water is introduced, and the screw set in the work so that the liquid goes up outside and descends inside the axis. The inner space is heated by steam. The electric effect takes place in the body of the liquid, and is complete in 12 hours. After resting an hour the aniline is decanted. The treatment of 100 kilogrammes of nitro-benzine requires 150 kilogrammes for disengagement of the hydrogen, plus 25 kilogrammes for decomposition of the sulphate and acid cleaning, or a total of 175, say, 200 kilogrammes per 100 kilogrammes of aniline obtained, which is not more economical than present processes; but the aniline is obtained in a state to be used without preliminary distillation on lime, according to usual processes.

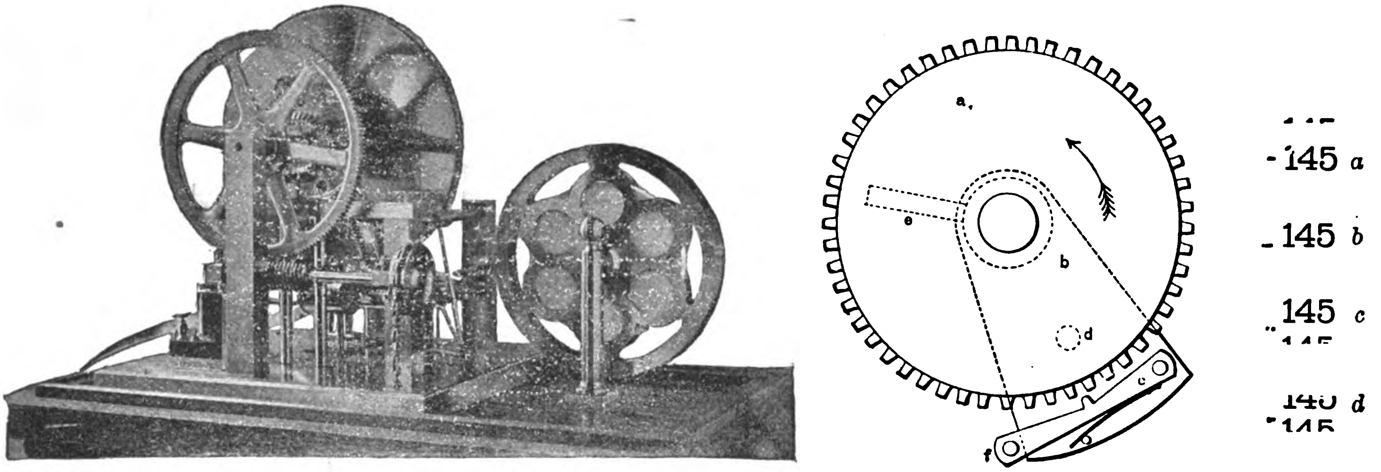
AN AUTOMATIC PRINTING SPEED-COUNTER FOR DYNAMO SHAFTING.[1]

BY PROF. GEO. S. MOLER.

THIS apparatus was designed and constructed to supply a need felt of having a continuous record of the speed of the shafting which drives the dynamos and other apparatus being used by students in their laboratory experiments.

The printer, Fig. 1, is essentially a speed-counter which prints the speed at the end of each minute upon a strip of paper, and does this continuously, requiring very little attention. It was built to give the speed of a shaft which runs at about 140 revolutions per minute, but it has a range of from 80 to 185 per minute. It is connected to the main shaft of the laboratory dynamo by sprocket-wheels and chains, so that the shaft carrying the worm revolves at exactly the same rate as the main shaft. The type-wheel is about eight and one-half inches in diameter, and is made by clamping printer's type between a disc and a ring fastened with screws to one side of it. The type are spaced so as to correspond with the number of teeth of the large gear-wheel which engages with the worm. The printing is done upon a one-half inch tape of district telegraph paper. The type-wheel practically starts from its zero, reading at the beginning of each minute.

The type-wheel, which is held by friction on the shaft, and is carried with it, is at the beginning of the minute slipped backward or forward until it has the correct relative position, then for the remainder of the minute revolves at the same rate as the large gear-wheel on the same shaft. The method of slipping the type-wheel around is partly shown in Fig. 2. A hammer is released at the end of each minute and, striking against the type, prints the record. Fig. 3 shows how the fraction of a revolution appears on the record. An exact number, 145, is shown at (*a*), 145.25 at (*b*), 145.5 at (*c*) and 145.75 at (*d*). Usually enough of either the preceding or following number is printed to easily make it out, and to estimate the fraction, which can be read to one-fifth of a revolution.



FIGS. 1, 2 AND 3.—AUTOMATIC PRINTING SPEED-COUNTER FOR DYNAMO SHAFTING.

The printer which has been described has been running for about three months and has not failed in any respect to do the work that was expected of it.

THE ELECTRIC HEATER.[2]

BY T. AHEARN.

INSTEAD of constructing heaters on the plan of a rheostat, the author prefers to conserve the heat within the heater up to a certain point beyond which it is not permitted to reach. Iron wire is also preferred as its resistance increases with the temperature. The benefit of this is felt when, as frequently happens, the E. M. F. is increased during short intervals. A baker's oven was built in the car shop of the Ottawa electric railway last July. This was of brick, eight feet square and in it were placed two of the author's 20 ampere, 50-volt cylindrical stoves. The interior of the oven was painted white and provided with incandescent lamps, and three pieces of plate glass, separated by air spaces, permitted the operation of cooking to be observed from start to finish. The oven was also furnished with a clock and a pyrometer, and the current so regulated that the latter registered 400 degrees Fahrenheit. A large dinner was perfectly cooked with this apparatus in 30 minutes, less than is usually required for the same work on a hotel range. This oven is now used for drying out repaired electrical parts of railway equipment and has been in constant use ever since it was started. A similar oven was used at the Central Canada Fair in Ottawa last year and attracted much attention, as did also a hot water radiator placed beneath the floor and lighted with incandescent lamps.

A conservatory in Ottawa has been electrically heated during the past winter by a furnace placed in the basement and controlled by switches on the floor above. The current was taken from the 50-volt lighting circuit. The total amount of pipe in the conservatory was 300 feet and the current absorbed was equal to 3 h. p., while the charge made by the light company was based upon the cost of an equal amount of power from a motor circuit. In another electrical hot water heater, a similar 50-volt furnace was constructed of five independent heaters radially connected to a common supply pipe, and the five sections mechanically and electrically connected in multiple. The sections were controlled by five 10-ampere switches conveniently placed in the rooms to be heated.

The author designed last Christmas an electric upright boiler to supply 85 lbs. of steam to a 1 h. p. engine for a display of the Chaudière Electric Light Company.

Here electricity was generated by water-power, converted into heat to make steam in the boiler, and the steam used for driving the engine, thus reversing the ordinary sequence.

The charge that is here made for current used in the numerous one gallon water heaters which have been largely introduced by the Chaudière Electric Light Company is based upon the amount charged for the 16 c. p. lamp, which is $8.00 per annum (the user paying for lamp renewals). Motor rates are charged for larger installations. These water heaters are used in barber shops, drug stores, bar-rooms, etc., and absorb three times as much current as one 16 c. p. lamp,—3 x 8 = $24. The company collects 50 cents per week for the current supplied each heater, making $26 per annum as against $24 if the same current was used for lighting. The charge is considered small by the users and the service is very satisfactory.

RECENT FORT WAYNE PLANTS.

THE FRANKLINVILLE ELECTRIC LIGHT COMPANY, of Franklinville, N. Y., has been incorporated with a capital stock of $12,000, with Dr. H. D. Walker, president, and W. H. Ferris, secretary. It has contracted with W. J. Morrison, general agent of the Fort Wayne Electric Company, for a complete plant, including a 40-light 2,000 c. p. dynamo of the Wood system and a 750-light new Wood iron-clad alternator. The plant is to be installed and ready for operation by July 15.

The Consolidated Electric Light Company of Greenwich, N. Y., have added another 40-light Wood arc dynamo to their new station. The Gluck Estate of Niagara Falls, N. Y., has just completed the installation of a 600-light incandescent plant of the Wood system, put in by Mr. E. T. Pardee of Syracuse, N. Y.

"YOUR MOST VALUABLE JOURNAL."

THE electrician of a large steam railroad renewing his subscription for the above, says: "I consider THE ELECTRICAL ENGINEER the most instructive and reliable journal published."

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[1] Abstract of a paper read before the American Institute of Electrical Engineers. May 17, 1893.

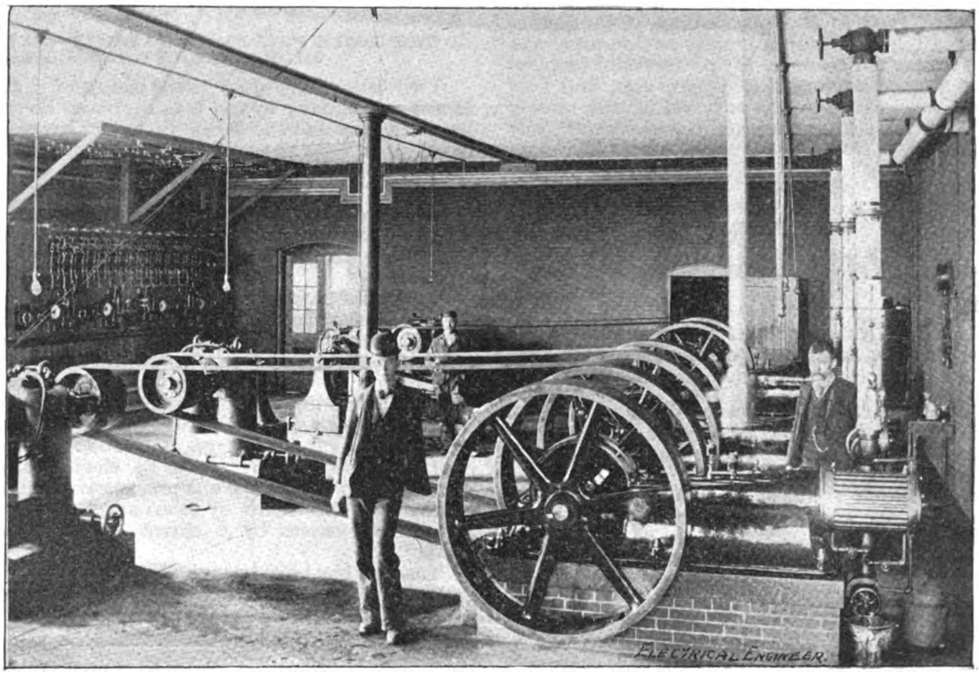
[2] Abstract of a Paper presented at the Chicago Electric Club, May 22, 1893

ELECTRIC LIGHTING OF THE HOUSE OF REFUGE, GLEN MILLS, PA.

It is now generally recognized by those in charge of large charitable and correctional institutions that considerations not only of economy, but of safety, dictate the employment of electricity as a mode of illumination. Following in the practice of other similar institutions, the managers of the House of Refuge, at Glen Mills, Delaware Co., Pa., have wisely equipped the newly erected building throughout with the electric light.

The contract for the plant was awarded to the Arnold Electric Manufacturing Co., of Chester, Pa., and our illustration is a view of the dynamo-room, from a recent photograph.

The specifications for the plant were drawn up by Mr. John Hoskin, electrical engineer for the building committee, and they required that the dynamo should make a continuous run with full load for five consecutive hours without the armature or fields heating more than 50 degrees Fahrenheit. They were also required to handle a change of load amounting to 80 per cent. without touching the rheostat, moving the brushes, or any other handling whatever; and they were not to increase their E. M. F. or to spark at the brushes during that test. They were required to convert not less than 92 per cent. of the mechanical energy into electrical energy, as shown by the motor test. In making this test each individual machine was run empty as a motor; the amount of current being consumed in the armature being noted, and also that in the fields. The armature under these conditions consumed five amperes at 110 volts, and the fields 2½ amperes, making a total loss of 7½ amperes, which divided by the capacity of the generator, 300 amperes, gave a loss of 2½ per cent. to which should be added the C^2R loss, making a total loss of 1,065 watts, or 3.2 per cent., thus showing a commercial efficiency of 96.8 per cent.



ARNOLD ELECTRIC LIGHTING PLANT, HOUSE OF REFUGE, GLEN MILLS, PA.

The heating tests showed an increase in temperature of one armature of 51 degrees Fahrenheit, and three showed 41 degrees Fahrenheit, after leaving the thermometer in the armature for fifteen minutes and covered with waste during that time. The temperature was not taken by the increase of resistance method. These machines were tested by the makers for an overload and 360 amperes were carried for a protracted run, the engines carrying the load quite comfortably and without any hitch.

The conductors are led from the dynamos in underground troughs to the back of the switchboard, shown in the engraving. It is made of quartered oak in 2¼ inch panels, and held together by two longitudinal strips of wood. The panels are fastened to these strips by screws in the centre of each panel, which allow the panels to warp and shrink independently of each other on their own centres. This board is 18 feet long by five feet high and handles nearly 2,500 lamps. Since it was erected it has developed no fault whatever.

The dynamo bearings have interchangeable bushings made of Crown bronze, and although they were made to operate as automatic oilers, Albany grease was found to lubricate without any difficulty whatever and has since been used in the cups. The commutator is made of rolled copper and the tangs are welded to the bars. The armature wires are soldered into brass clips, which are in turn bolted to the tangs with two hexagonal cap bolts.

The core is built up of Norway iron discs, which are insulated from each other by a special insulating fireproof paint. and are further insulated from the shaft to prevent Foucault currents from circulating in the shaft. The pole-pieces are of soft iron and the limbs are of wrought iron forgings. Their most economical point of operation is at 118 volts, the pressure at which they are run to allow for loss in the feeders to the centres of distribution.

This installation is claimed to be one of the most economical that was ever installed, as it was the desire of the electrical engineer in charge to pay a bonus for any increase in efficiency over 92 per cent.

The steam plant was installed by Messrs. J. W. Parker & Co., of Philadelphia, and consists of two 10 x 12 inch and one 12 x 14 inch Ball engines, of Erie, Pa.

NIAGARA LIGHT AND POWER CONTRACTS.

The Niagara Falls Power Company has, it is stated, made a contract with the Cataract Electric companies, of Rochester and Jamestown, to furnish power. The right to furnish electrical power all over the State has been granted the Power Company in the amendment to its charter passed by the last Legislature and approved by Gov. Flower on April 25. Section 2 of this amendment gives the Power Company the right "to conduct, convey and furnish the water of the Niagara River, but not in excess of the amount heretofore expressly authorized by law, or any power, heat or light developed therefrom, to, in, and through any civil division of this State, and to sell, furnish and deliver the same to any and all bodies or persons, public or private, wherever situated." This gives the Niagara Falls Power Company the great Empire State as its field to operate in. In the original charter its field of operation was confined to Erie and Niagara counties.

NUTLEY'S IDEA OF THE PROPER THING.

A special meeting of the Town Committee of Nutley, N. J., in settling the electric railway question, adopted the following regulations: That the company furnish double tracks to be laid in the centre of the road; that Belgian blocks be used between the rails, and the roads to be macadamized on each side of the track to the gutter line; that the poles be 25 feet high and placed on the side of the roads; that wires be not strung less than 20 feet from centre of road bed; that shade-trees be not disturbed, and that the company keep the highways in repair under supervision of the Town Committee; the fare to Newark or Paterson to be five cents, and the company to be exempted from taxes for five years, after that the tax to be no less than $10 for each car, and the road to be built within six months after signing the contract.

LETTERS TO THE EDITOR.

"POLYPHASE" PRESUMABLY PREFERABLE.

It is encouraging that engineers as well as the ultra-technical people are beginning to require more clearness and accuracy in the rhetoric of electrical literature than has been used in many past instances. Electrical science, which of all others would seem to demand exactness and precision in its demonstration, may be robbed of much of its apparent value by careless forms of speech or unclear statements.

In the same line it is noticeable that quite a number of impure words and phrases have crept into frequent use. As an example, it is very common to use "multiphase," a word of mixed derivation, for the more natural and correct form "polyphase." This particular expression seems to have come into almost exclusive use in this country, and it would be interesting to know how and why it came so. There are numerous other errors of the same sort, which could as well be weeded out at present along with the general crop of technical mistakes.

Lucius E. Marple.

Chicago, May 26, 1893.

A DISCLAIMER FROM PARK BENJAMIN.

I have just learned that my name still remains of record as principal attorney in a very old application for patent of Daniel Drawbaugh, which is involved in the proceedings in the Patent Office taken by Messrs. Church & Church against ex-Commissioner Simonds and Messrs. Foster & Freeman. My professional employment by the Drawbaugh interest terminated years ago; and now that my attention has been called to the survival of this merely technical and quite forgotten relation, a prompt withdrawal, duly filed, has ended that also.

Park Benjamin.

New York, May 29, 1893.

REPORTS OF COMPANIES.

THE NATIONAL ELECTRIC MANUFACTURING COMPANY ASKS FOR A RECEIVER. THE PLANT TO BE OPERATED WITHOUT INTERRUPTION.

In the Eau Claire, Wis., Circuit Court proceedings were taken on May 23, by which the National Electric Manufacturing Company's plant of Eau Claire, Wis., passed into the hands of a receiver, as noted last week.

The event causes a sensation so far as the public is concerned, but the matter has been under consideration for some time. An action had been brought by Jas. T. Barber, *et al*, against the National Electric Manufacturing Company, H. H. Hayden being the attorney for the plaintiff, the complaint in which sets forth that the company was embarrassed by very pressing claims on the part of creditors which it was unable to pay; that the large plant and valuable business of the company could best be preserved in their entirety for the benefit of all concerned, by the appointment of a receiver, etc., etc. Mr. Hayden requested the appointment of Ralph E. Rust as receiver; bond being offered in the sum of $50,000, with William A. Rust, John S. Owen, Jas. T. Barber and Fitch Gilbert as sureties. The same being properly filed, Judge Bailey made an order appointing Mr. Rust receiver.

Although the company by reason of the general financial stringency, has been considerably embarrassed, the conditions are such that under the receiver the business can and will be carried on without any interruption whatever. There will be no stoppage, and a reorganization will probably be effected within a very few days.

The company's plant is claimed to be worth $300,000; there is a large amount of valuable manufacturing products on hand, and there are also large outstanding orders. The assets foot up between $500,000 and $600,000; the liabilities are about $300,000.

The placing of the plant and affairs of the company in the hands of a receiver is regarded as the very best possible solution of the difficulties which have been encountered. It practically saves the business and its preservation in this manner is considered a fortunate outcome.

EDISON ILLUMINATING COMPANY OF NEW YORK.

The Edison Electric Illuminating Company reports gross earnings for April of $102,093, an increase of $26,689 as compared with the same month of last year, and net $45,940, an increase of $4,614. For the four months ending April 30 the gross earnings were $431,058, an increase of $119,228 as compared with the corresponding period of last year, and net $210,717, an increase of $48,823.

ELECTRIC BUILDING, LOAN AND SAVINGS ASSOCIATION.

The above-named association makes an excellent showing for the year ended Dec. 31, 1892. It is largely composed of Postal Telegraph officers and employees, and Mr. A. B. Chandler is the efficient president, putting into his work for it the thoroughness that marks all his actions. The Association now has about $30,000 loaned on bond and mortgage, and is of great service to many men who otherwise would not be able to secure homes of their own to live in.

THE STIRLING COMPANY.

We are informed that the rumor that Mr. O. C. Barber had resigned the presidency of the Stirling Company, manufacturers of the well-known Stirling safety water-tube boilers, is entirely without foundation. In fact there is no more active and enthusiastic member in the whole company. The resignation of Mr. Crankshaw as treasurer may have given rise to this report.

The present officers of the company are as follows: O. C. Barber, president; J. K. Robinson, vice-president; Thomas Deegan, secretary and general manager; E. R. Stettinius, treasurer; H. S. Pell, superintendent, and Fred. A. Scheffler, general sales agent, with offices at 74 Cortlandt, street, New York.

The shops of the company are at Barberton, Ohio.

LEGAL NOTES.

THE TESLA POLYPHASE PATENTS—WESTINGHOUSE *vs.* THOMSON-HOUSTON ELECTRIC CO.

Two suits have just been instituted against the Thomson-Houston Company by the Westinghouse Electric and Manufacturing Company and the Tesla Electric Company. These suits are based upon four patents of Nikola Tesla relating to the system of transmitting electric power by "multiphase" alternating electric currents. The patents said to be infringed were issued May 1st, 1888, and are numbered respectively 381,968, 381,969, 382,280 and 382,281. We give below the claims of the two latter patents which are the method patents, the two former claiming the apparatus.

The claim of patent No. 382,280 is: "The method herein described of electrically transmitting power, which consists in producing a continuously progressive shifting of the polarities of either or both elements (the armature or field magnet or magnets) of a motor by developing alternating currents in independent circuits, including the magnetizing coils of either or both elements, as herein set forth."

The claim of patent No. 382,281 is: "The method herein described of transmitting power by electromagnetic motors, which consists in continuously and progressively shifting the poles of one element of the motor by alternating currents and magnetizing the other element by a direct or continuous current, as set forth."

The suit has been brought in the U. S. Circuit Court at Hartford, and a specific infringement is in the plant for transmitting power from Farmington to Hartford.

THE OCONTO LAMP CASE.

On June 2, the case of the Edison Electric Light Company *vs.* the Electric Manufacturing Company, of Oconto, Wis., came up for hearing in the U. S. Circuit Court, at Wilwaukee. The defendants filed a large number of affidavits and exhibits including the Goebel lamps. The complainants filed seventeen affidavits denying the genuineness of the lamps submitted by the defendants. The latter were given until June 26 to file answering affidavits and the further hearing was set down for July 3.

1,000 H. P. ENGINE FOR THE HUDSON COMPANY'S POWER STATION, HOBOKEN, N. J.

The Pennsylvania General Electric Company, for the Hudson Electric Light and Power Company, Hoboken, N. J., have placed an order with the Philadelphia Engineering Works, Limited, for nominally a 1,000 h. p. cross-compound condensing engine. This engine has a high pressure cylinder 26 inches in diameter, low pressure cylinder 50 inches in diameter and 54-inch stroke. It is intended strictly for electric railway work, and is built excessively heavy, as may be gleaned from the fact that the journals are 16 inches in diameter and 30 inches long, centre shaft 18 inches in diameter. The band wheel is to be 22 feet in diameter. 74 inch face, weight 100,000 pounds when finished. The greatest care is taken in designing and securing this wheel. All port areas of both cylinders are excessively large, the low pressure being three times larger than the high.

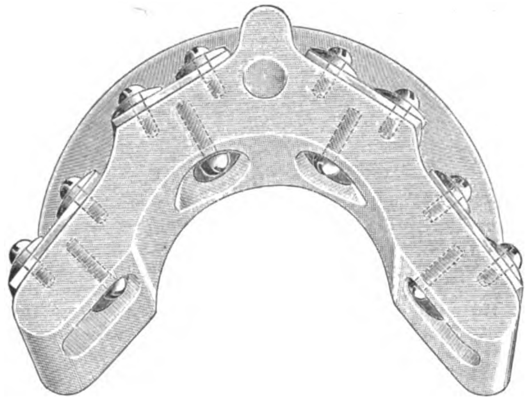
It is to have an independent condenser, supplied with two 24-inch air cylinders, 10-inch stroke traveling in opposite directions. The receiver is made of good capacity, and thoroughly reheated with numerous solid-drawn brass tubes running through it, thus revivifying and practically superheating the steam while entering the low pressure cylinder. The plan adopted in proportions will be much the same as the two vertical cross-compound condensing engines, built by the Philadelphia Engineering Works, Limited, for the Hudson Electric Light Company, between which this horizontal engine is to be placed. These vertical cross-compound engines have given very satisfactory results, running at 100 revolutions per minute, developing about 600 h. p., but frequently reaching 800 h. p. It was the excellent economy and satisfactory results achieved by these engines, which warranted the Company in placing this order with this engineering firm. These Works have now on hand three 50-inch Corliss cylinders, 6-feet stroke, for compressing air for the blast furnace at Poughkeepsie, N. Y. The fly wheels are 100,000 pounds weight, and 24 feet diameter. The frames are not of the ordinary Corliss, but of box form, a type used more generally in England than America. In addition to these, they have quite a number of from 200 to 400 h. p. Corliss engines, of standard type and progress, all being built to order.

"HORSESHOE" FIXTURE CUT-OUT.

THE accompanying engraving shows a new "Horseshoe" fixture cut-out manufactured by the Imperial Porcelain Works, of Trenton, N. J., and patented by Mr. Frederic A. Duggan, of the same city. His patent bears date of June 1. The claims for this cut-out are its simplicity in construction and ease of assembling. The brasses being straight instead of bent, the cost of brasses is reduced at least one-third, it is said, below any other fixture now on the market. They will fit any size of canopy, and are made of thoroughly vitrified porcelain.

The Imperial Porcelain Works in placing these cut-outs on the market, want it understood that they manufacture the porcelain part only, although their patent thoroughly covers it, with or without brasses. They extend the privilege to those who may favor them with their orders, to attach the brasses themselves.

Jobbers and supply houses will find them on sale at all the leading establishments in the country. The Works will cheerfully send samples to anyone upon application.



"HORSE-SHOE" FIXTURE CUT-OUT.

The Imperial Works have recently extended their facilities for manufacturing porcelain of every description, and pay particular attention to difficult work. They are about to introduce an interchangeable cleat for use on either the two or the three wire system.

ELECTRIC HEATING.[1]

BY S. B. JENKINS.

THE author began by giving a brief history of the development of electric heating, stating that his purpose was to show what had been accomplished in this direction as exemplified by the apparatus of the American Electric Heating Corporation, of Boston. It is sought to produce heat only when and where needed, and ovens, boilers, sectional radiators, and a complete equipment for kitchen, laundry and pantry utensils are made on this principle. Work is done in much less time and with almost infinitely less labor than by the methods ordinarily employed, while the first cost of the outfits are about the same. Soldering irons, brazing tools, muffles and smoothing irons partake of the same general advantages and electric cars are electrically heated equably, comfortably and easily. All this apparatus is made for either direct or alternating current at potentials varying from 25 to 118 volts, except the car and house heaters, the former of which operate at from 400 to 500 and the latter at from 104 to 236 volts.

The author then detailed the results of a number of practical tests as follows:

A hot-water reservoir constructed of copper, tinned on the inside, nickeled on the outside, and having a contents of 23 pounds of water at 60 Fah., without jacketing, and having an electrically heated bottom forming an integral part of the vessel, had placed in it 16 pounds of water from the service tap, at a temperature of 57 Fah. This was raised to 128 Fah. in 20 minutes, or an effect was produced of 1,136 pounds degree Fah., with an expenditure of electrical energy amounting to 0.326 h.-p. hour, which, at the contract price for power when and where this test was made, of five cents per h.-p. hour, costs $0.0163, and the pound degrees Fah. costs $0.00001434.

The cost of boiling one gallon from 40 degrees Fah. does not exceed two cents, by actual test, at this rate for energy. Some 500 heat units are expended in heating the vessel, and in radiation, so that the actual cost of the heat unit is, in round numbers, one-thousandth of one cent.

In the oven, 10 pounds of beef have been roasted, 2 loaves of bread baked, and 12 plates heated for serving, all in 90 minutes, "from the cold," with an expenditure of energy amounting to 1.5 h.-p. hour, or 1,119 watt-hours; this at five cents per h.-p. hour is 7½ cents; or at 10 cents per h.-p. hour, is 15 cents. At the 5-cent rate this oven costs about 2½ cents per hour, the first expense of "heating up" being gradually eliminated with each hour of continued service. Chops are cooked for 1 cent, an oyster stew made for ½ cent, tea and coffee for 4-tenths of a cent, all in sufficient quantities for the ordinary table, the energy rate being 5 cents per h.-p. hour.

Large electric cars are heated to 60 Fah. under all weather conditions, with an average rate of consumption of energy of 1,000 watts, in the climate of Boston. This should be very satisfactory, though no exact figures of expense can be given, as the cost of power on electric railways is not stated. It is fair to assume that it costs not more than 40 cents per car day of 18 hours. When electric cars are heated, they undoubtedly divert to themselves sufficient carriage patronage to pay for the heating.

The average well-built city house in a block requires an equipment for heating, on the basis of an expenditure of electrical energy of 1 h. p. per 1,200 cubic feet of space, though this amount is by no means required to be used continuously, and is stated as a maximum. It is impossible to give any exact figures unless for a particular instance when all the conditions are precisely stated. Steam heating engineers with long experience and voluminous data are accustomed to calculate the individual requirements, and only then will they guarantee results.

Tyndall's estimates being accepted, that in a stove, 6 per cent. or 780 heat units of the 13,000 in one pound of coal were utilized as a maximum, and assuming that 800 are now utilized, then 2,000 pounds of coal produce in useful effect 1,600,000 heat units.

One h.-p. hour of electricity produces 2,562 heat units, and upon this basis the following comparative table of the useful heat from coal and that from electricity has been calculated.

A h.-p. year is assumed to be 4,000 hours out of the 8,760 which the year contains.

Electricity.			Coal.
Per Watt-Hour.	Per H.-P. Hour.	Per H.-P. Year.	Per 2,000 pounds delivered.
$.000013405	$0.001	$4.00	$0.624
	.002	8.00	1.248
	.003	12.00	1.872
	.004	16.00	2.496
.000067025	.005	20.00	3.12
.00008043	.006	24.00	3.741
.000093835	.007	28.00	4.368
.00010724	.008	32.00	4.992
.000120645	.009	36.00	5.61
.00013405	.01	40.00	6.24
.0002681	.02	80.00	12.48
.00040215	.03	120.00	18.72
.0005362	.04	160.00	24.96
.00067025	.05	200.00	31.20
.0008043	.06	240.00	37.44
.00093835	.07	280.00	
.0010724	.08	320.00	
.00120645	.09	360.00	
.0013405	.10	400.00	

In round numbers, electricity at $0.015 per h.-p. hour or $60.00 per h.-p. year of 4,000 hours (which is 11 hours per diem on an average) is equivalent in practical useful heating effect to coal at $6.00 per ton, and the coal must be hard coal of best quality, burned with good ordinary care and discretion. This is on the basis of a contract for power as follows: viz:, Consumer of power agrees to pay $60.00 per horse-power, per year, using it whenever he chooses—all the time if he desires—perhaps 8,760 hours; but the average use of the householder under average circumstances, would be 4,000 hours only—or 11 hours per diem throughout the year, except in sections of the United States south of Mason and Dixon line, where it would average about 3,000 hours only.

The preceding estimate is for the heating of houses only; the cooking is on a different basis entirely, as electricity at five cents per h.-p. hour, will compete directly with coal at $5.50 per ton of 2,000 pounds.

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[1] Abstract of a Paper presented at the Chicago Electric Club, May 23, 1893.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED MAY 31, 1893.

Alarms and Signals :—

Fire-Alarm System, J. Sachs, New York, N. Y., 498,418. Filed June 24, 1892.

Improvement on the system patented by the same inventor Aug. 30, 1892, No. 481,590.

Electric Alarm-Clock, W. M. Fowler, Milford, Conn., 498,468. Filed May 6, 1892.

Mail-Receptacle, A. Holtum, Racine, Wis., 498,550. Filed Oct. 18, 1892.

To operate a signal when mail is deposited.

Electric Time-Alarm, C. S. Gibson, South New Berlin, N. Y., 498,710. Filed Oct. 12, 1892.

Batteries, Primary :—

Galvanic Battery, W. Burnley, North East, Pa., 498,422. Filed June 15, 1892.

A dry battery.

Distribution :—

System of Supplying Currents to Electric Railways. C. Zipernowsky, Buda-Pesth, Austria-Hungary, 498,603. Filed March 7, 1891.

Claim 1 follows:—

In a system of electrical distribution and conversion, high potential alternating current primary conductors and low potential continuous current secondary mains in combination with a number of intermediate converting appliances, each consisting of a combined alternating current motor and a continuous current dynamo connected up to the primary and secondary conductors which latter are common to the several converting appliances, substantially as described, whereby the dynamo of each converting appliance is first supplied with continuous current from the common secondary mains to start its motor, and the latter then drives the dynamo to supply current to said secondary mains.

Dynamos and Motors :—

Pole Piece for Dynamo Electric Machines, E. Thomson, Swampscott, Mass., 498,327. Filed Aug. 26, 1892.

Designed to minimize the effect of eddy currents. Has in its face a number of slots, each containing heat resisting and insulating material.

Dynamo Electric Machine, C. E. Dressler, New York, N. Y., 498 537. Filed Oct. 6, 1891.

Pole piece of soft iron is provided with hardened steel pins inserted in poles; field consists of radial magnets; armature consists of a core and a series of radial magnets; an induction coil is placed at the side of the armature magnets and at right angles to the armature axis.

Electric Generator Motor, C. E. Dressler, New York, N. Y., 498,538. Filed Sept. 15, 1892.

Has composite field pole pieces of soft iron and magnetized steel alternated with intervening material of non-magnetic conductivity.

Electrical Rotary Motor, W. J. Still, Toronto, Can., 498,585. Filed Dec. 28, 1891.

Adapted to promote rapid demagnetization of field magnets.

Ignition:—

Gas Lighting or Extinguishing Apparatus, J. Sangster, Buffalo, N. Y., 498,492. Filed Dec. 27, 1892.

Lamps and Appurtenances :—

Electric Arc Lamp, L. Hills, New York, N. Y., 498,269. Filed Sept. 2, 1891.

Adapted to focusing lamps and for keeping a uniform feed in all inclinations of the lamp.

Electric Lighting System, C. E. Scribner, Chicago, Ill., 498,312. Filed June 1, 1889.

Adapted especially for incandescent lighting, and designed to control lamps singly, or in groups, both locally and from a controlling station.

Adapter for Lamp Sockets, H. P. Ball, Schenectady, N. Y., 498,374. Filed July 6, 1892.

Designed for use with lamps of different types.

Electric Arc Lamp, F. D'A. Gould, New York, N. Y., 498,387. Filed Nov. 7, 1891.

Instead of carbon rods and the usual feeding motion employs nearly concentric rings, one of which may be drawn away from the other by the action of an electromagnet.

Electric Arc Lamp, P. Nordmann, Berlin, Germany, 498,566. Filed Nov. 16, 1892.

Adapted for constant potental circuits and includes two or more pairs of carbons for separate or simultaneous use.

Electric Arc Lamp, H. Alexander, Brooklyn, N. Y., 498,604. Filed April 19, 1890.

Regulating device.

Metal Working :—

Electric Welding Apparatus, J. H. Bassler, Myerstown, Pa , 498,735. Filed Aug. 23, 1892.

Relates to the class of apparatus employing high tension current to produce an arc for heating.

Miscellaneous :—

Electric Registering Device, B. B. Ward, New York, N. Y., 498,372. Filed May 28, 1890.

For registering at a distance the revolutions of a shaft or other body.

Insulator Binding-Post, R H. Rich, Beverly, Mass., 498,407. Filed July 15, 1892.

Electric Rotary Fan, J. F. Denison, New Haven, Conn., 498,462. Filed March 15, 1892.

Relates to the connection of the fan with the motor.

Junction-Block for Electric Fixtures, F. A. Duggan, Trenton, N. J., 498,539. Filed Feb. 24, 1893.

Electric Cut-Out, W. P. Mashinter, Montreal, Can., 498,560. Filed July 5, 1892.

Automatic Cut-Out for Musical Instruments, C. Riegger, Louisville, Ky., 498,573. Filed Dec. 16, 1892.

Adapted for use with instruments employing punched music paper.

Revolving Fuse-Holder, C. H. Ruggles, Lynn, Mass., 498,698. Filed Dec. 12, 1892.

Copper-Coating for Hulls of Vessels, T. S. Crane, East Orange, N. J., 498,707. Filed Oct. 12, 1892.

Forms an integral coating upon a large surface by depositing the metal in successive portions, overlapping each other.

Galvanic Battery and Electrical Toy Instrument, W. A. Connelly, Boston, Mass., 498,743. Filed Sept. 1, 1892.

Railways and Appliances :—

Station Indicator, M. Manuel, Vienna, Austria-Hungary, 498,280. Filed Sept. 5, 1892.

For railroad trains.

Railway-Block Signaling System, A. S. McCaskey, Chichgo, Ill., 498,290. Filed July 29, 1892.

Employs currents of opposite polarity for setting and lowering signals, respectively.

Trolley-Catcher, C. A. Lord, San Francisco, Cal., 498,355. Filed July 12, 1892.

To care for the trolley when it flies off.

Electric Railway Trolley, R. M. Hunter, Philadelphia, Pa., 498,485. Filed June 7, 1888.

Includes a joint permitting universal movement and complete reversal.

Clearer for Slotted Conduits, J. C. Love, Chicago, Ill., 498,437. Filed May 17, 1892.

Consists of a bar adapted to be lowered from the car to clear the slot in the conduit.

Electric Locomotive, A. Schmid, Alleghany, Pa., 498,577. Filed Nov. 16, 1891.

Relates to the design and construction of railway car motors.

Operating Street or Station Indicator, R. B. Ayres, New York, N. Y 498,607. Filed Dec. 22, 1891.

Employs current from the trolley wire.

Electric Car Brake, N. J. Clute, Schenectady, N. Y., 498,624. Filed Oct. 24, 1892.

An electromagnetic brake arranged to have the greatest power of the mechanism exerted when the solenoid has reached its weakest point.

Electric Railway Trolley, R. D. Nuttall, Alleghany, Pa., 498,723. Filed May 10, 1892.

Relates to the spring or springs of the trolley support.

Telegraphs :—

Electrical Signaling System, A. S. McCaskey, Chicago, Ill., 498,289. Filed July 29, 1892.

A printing-telegraph. Makes each letter by a distinct combination of circuit changes.

Printing-Telegraph, E. V. Baillard, New Utrecht, N. Y., 498,529. Filed Feb. 4, 1893.

A step-by-step method.

Printing-Telegraph, D. Murray, Sydney, New South Wales, 498,674. Filed Nov. 2, 1892.

Designed to operate typewriters at a distance.

Telephones and Apparatus :—

Telephone System, E. A. Clark, Sioux City, Ia , 498,286. Filed April 5, 1892.

An automatic exchange system.

Telephone-Switch, A. G. Davis, Baltimore, Md., 498,243. Filed Nov. 25, 1892.

A circuit opening and closing device controlled by an elbow-rest.

Automatic Telephone Exchange System, A. S. McCaskey, Chicago, Ill., 498,291. Filed Aug. 25, 1892.

Telephone-Transmitter, C. F. Scattergood, Albany, N. Y., 498,309. Filed Dec. 14, 1892.

Instead of a diaphragm employs a delicate, flat, tubular spring, the opening of the mouth-piece communicating with the interior of the tubular spring.

OBITUARY.

BURIAL OF PROF. FARMER.

THE public funeral services of Professor Moses G. Farmer were held at the South Congregational Church in Boston at noon on Monday, May 29. The chancel had been beautified by a tasteful and harmonious grouping of ferns, flowers and potted plants, arranged by loving hands. The services were opened by a prayer by Rev. Edward Everett Hale, and the singing of the anthem "Come unto me," exquisitely rendered by Mrs. Humphrey Allen. Selections from the scriptures were read by Rev. Mr. Boyer of Chicago, after which the Rev. Augustin Caldwell, of Ipswich, pronounced a most appreciative and discriminating eulogy, in the course of which he sketched at some length the remarkable career of Professor Farmer as a scientist and as a man, referring to his life as a continuity of evolution. His unusual mental gifts and his inventive faculties were fittingly referred to, and his many domestic virtues, his kindness and charity for all, his uniform patience and sweetness of disposition, and his strong attachment for his home and family were tenderly dwelt upon. The Rev. Mr. Boyer followed with further appropriate selections from the scriptures, the reading of a poem, and a few fitting words of comment upon the text. Dr. Hale made a closing prayer, and the congregation then joined in singing "Nearer my God to Thee" and were dismissed with the benediction. Among the pall-bearers were Captain Selfridge, U. S. N., Professor Elihu Thomson, Franklin L. Pope, Charles F. Washburn, and other old professional and social friends. One of the most sincere mourners in attendance was the well-known waterman, Captain Tom Shay, of Newport, R. I., who has always cherished an almost unbounded affection for Professor Farmer and his family for their numerous deeds of kindness to him while they were residing at the Torpedo station. At the conclusion of the services in the church, the body was taken by train to the family home at Bitter-sweet-in-the-fields, Eliot, Me., where the burial took place on Memorial day, attended by the family and the immediate neighbors.

ELECTRICITY ON THE CANALS.

SUPERINTENDENT HANNAN of the New York State Department of Public Works has issued an order providing that all parties desirous of experimenting with electricity or other power for propelling boats on the canals must have their applications for such privilege on file in his department by June 5.

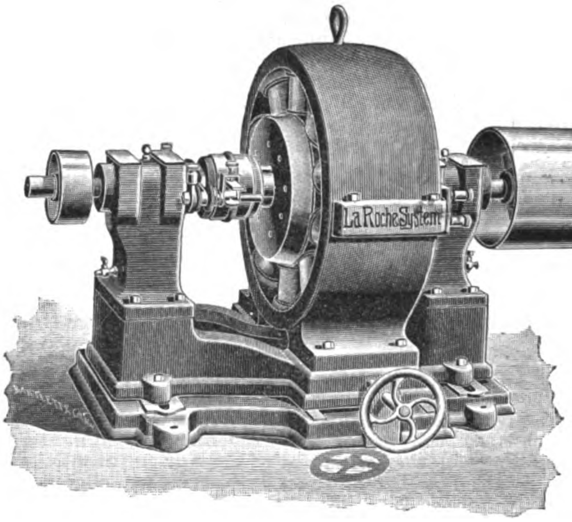
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE LA ROCHE NEW ALTERNATING DYNAMO.

The accompanying engraving represents one of the types of alternating machines built by the well-known La Roche Electric Works, of Philadelphia. This company was one of the first in America to make a specialty of alternating apparatus, and the demand for their alternating machines has been so great that they were compelled to design a full line of small alternators, and now build them to operate at a capacity of from 25 up to 3,000 lights. The La Roche machines are made in two classes, self-exciting and separately excited.

The machines from 25 lights up to 500 lights are arranged with ten poles running at 1,600 revolutions, thus giving 16,000 alternations per minute. The larger machines have a larger number of poles and give the same frequency, but at a lower speed. The alternators have all modern improvements with all parts interchangeable and made to gauge, and have been designed by Mr. F. A. La Roche. They have self-oiling bearings and an automatic oil-overflow. The brush-holders are of a new design and so made that any degree of tension can be secured. The machine has two collector rings which are made of specially hardened copper well insulated with mica.



New La Roche Alternator.

The fields in even the smaller machines are made separable so that any repair work can be done without interfering with the rest of the machine. The field bobbins are separately wound and slipped over the core and any of them can be replaced, in case of necessity, in a very few minutes.

The armature is built up of the best laminated, pure charcoal iron, well insulated magnetically. The core is mounted on two of the La Roche latest bronze spiders well screwed to polished steel shaft. Where it enters the bearings the shaft is turned down to standard size. The armature coils are separately wound and any intelligent person can replace any or all in a very few minutes, as the company employs a new method of securing the coils to the core. They also have a new method of connecting and winding the armature whereby the difference of potential between coils never exceeds 200 volts. The coils are insulated from the core of the armature by the best grade of mica that can be procured so that it is almost an impossibility to have a burn-out or short-circuit from lightning. The illustration represents the separately-excited machine without the exciter attached.

At a test of some of these machines it was shown that there was a variation of only $2\frac{8}{10}$ volts between no load and full load, a very satisfactory result for alternating machines.

All the machines have a cast-iron sub-base, well secured and mounted so that no foundation is required, as the sub-base answers that purpose.

The La Roche Company has furnished alternators to such well-known institutions and firms as the University of Wisconsin, Queen & Co., Incor., Philadelphia; Helios Electric Company, Philadelphia, etc., and they possess flattering testimonals from all parties using their system.

The La Roche Company is to be congratulated upon the success not only of its alternating system, but also its direct current and arc system. It is one of the most flourishing companies of this kind in the country and has grown to its present magnitude from a small room, 8 x 12 feet, and this has been largely due to the energy and ability exhibited by their Mr. F. A. La Roche. The La Roche Electric Works will in a short time move to their new factory, which will be one of the largest of the kind in this country.

NEW YORK NOTES.

Keuffel & Esser Co., 127 Fulton street, are now in full occupancy of their beautiful new building where in spacious showrooms, well-lighted from all sides, they display their splendid assortment of engineering instruments, drawing materials, etc. The building is one of the handsomest in the neighborhood, and its contents are of no less excellent quality.

The Premier-De Mott Blue-Stone Battery.—A recent careful test of this battery made by Mr. Edward Blakeney showed it to be capable of delivering a practically constant current on short circuit of 2.39 amperes, with an E. M. F. of 1.079 volt, the internal resistance being less than half an ohm.

The Manhattan Electrical Supply Company, of 36 Cortlandt street, this city, have issued an edition of 50,000 copies of a pocket size of their catalogue and price list. It embraces all their novelties, house furnishings and standard electrical supplies, and is a very handy and useful little publication.

Dr. Park Benjamin, the well-known patent expert and scientific authority, has removed to commodious offices in the Mail and Express Building, 203 Broadway, where he has also installed his fine technical and electrical library.

Mr. F. R. Chinnock, of the New York office of the Ball Engine Company, of Erie, Pa., has recently taken an order for a 125 h. p. engine from the Far Rockaway Electric Light Company, Far Rockaway, L. I.

WESTERN NOTES.

The Railway Equipment Company, Chicago, reports contracts made for their type "G" overhead material during the last few weeks with Tiffin, O., Electric Railway Company; Belle City Street Railway Company, Racine, Wis.; Norristown, Pa., Electric Railway Company; South Chicago City Railway Company; Mobile, Ala., Electric Light and Power Company; Camden & Atlantic Railroad Company, Atlantic City and Camden; Calumet Electric Street Railway Company, Chicago; Trenton, N. J., Iron Company; Columbia, Pa.,& Ironville Street Railway Company; Lehigh Traction Company, Hazleton, Pa.; Wheeling, W. Va., Railway Company; Wichita, Kas.,Electric Railway Company; Fox River Street Railway Company, Green Bay, Wis.; Pottstown, Pa., Passenger Railway Company; Wyandotte & Detroit River Railway Company, Ecorse, Mich.; Cumberland, Md., Electric Railway; Montreal, Can.,Street Railway; Independence, Iowa & Rush Park Railway; Westminster & Vancouver Tramway Company; Gettysburgh, Pa., Electric Railway; Second Ave. Passenger Railway, Pittsburgh; Pittsburgh & West End Passenger Railway; Escanaba, Mich. Electric Street Railway Company; Atlantic Ave. Railroad Company, Brooklyn; Hammond, Ind.,Electric Railway Company.

The Electric Appliance Company are showing a very attractive line of Meston alternating current motors for special work at their World's Fair exhibit, space U 16. The Emerson Company, manufacturers of the celebrated Meston motors and for whom the Electric Appliance Company are general western agents, have made some new applications of their motors this season. They now have their alternating motor applied to a dental outfit and also as a sewing-machine motor, both being exceedingly practical combinations. Another specialty of this season is their revolving motor which is a very ingenious piece of mechanism, and a motor which promises to be very popular for ventilating purposes.

Mr. J. H. Cook, Chicago, manager of the Buckeye Electric Company, manufacturers of the Buckeye lamp, is in receipt of many orders for lamps. Mr. Cook carries at all times a large stock of lamps enabling him to fill "immediately" orders for lamps of any voltage and any socket. This is a great convenience to the purchaser and necessitates the carrying a full stock at all times.

Mr. Lucius T. Gibbs has resigned his position as electrical engineer of the Milwaukee Street Railway Company, to engage in a general consulting business in both mechanical and electrical lines. His office will be 1103 Pabst Building, Milwaukee, Wis.

Mr. W. Hubbard, the electrician, well-known in connection with the Elgin acoustic telephone, informs us that the new address of Wm. Hubbard & Co., is Suite 55, No. 94 La Salle street, Chicago.

Habirshaw. Very large sales of Habirshaw wire during the past week have been reported to us as having been made by the Ansonia Electric Company.

ROSE POLYTECHNIC INSTITUTE.

The Rose Polytechnic Institute is one of our leading Engineering Colleges, and is especially fortunate in its thoroughly modern equipment and plan of instruction. It lays special emphasis on the practical side of technical education, which it is enabled to do throughout the whole course of four years by its ample shops and laboratories and exceptionally complete outfit, especially in electricity.

A REMARKABLE RECORD IN BOILERS.

4,000 h. p. of Stirling boilers was sold in one week, from May 5, 1893, to May 12, 1893. The list is subjoined:

Ætna Iron Co., Bridgeport, Ohio (4th order)...	1,000 h. p.
Whitman & Barnes Co., Chicago (2d order)....	1,000 h. p.
Cleveland Cable St. Ry. Co., Cleveland, Ohio...	750 h. p.
Allentown Electric St. Ry Co., Allentown, Pa.	900 h. p.
La Fayette St. Ry. Co., La Fayette, Ind. (2d order....................................	250 h. p.
Hope Co., Hope, R. I	100 h. p.
	4,000 h. p.

The sales of the Stirling boiler from March 1, 1892, to March 1, 1893, amounted to 58,000 h. p. This is said to be the largest record ever made by any boiler in the fifth year of its existence. Nothing could more clearly demonstrate the great popularity of this boiler.

ANSONIA ELECTRIC COMPANY.

The exhibit of magnet, line and rubber covered wire in the Ansonia Electric Company's booth at the Fair grounds, will give their customers some idea of the complete line of wire which they carry.

The new W. W. Lightning Arrester is giving the best of success and the Ansonia Electric Company are prepared to furnish them in large quantities on short notice.

The Ansonia Electric Company recently secured an order for the entire equipment of the Columbia, Mo., plant for Stanley transformers.

SUTTON-STEELE ELECTRIC MANUFACTURING COMPANY.

The above company is the outgrowth of the original firm of Sutton & Steele, of Dallas, Tex. Its object is to manufacture all kinds of electrical machinery, supplies, apparatus, etc.; also to engage in the construction, operation and sale of electric light plants for buildings, factories, towns, etc. C. A. Ginocchio is president of the company; J. B. Lanci, vice-president, and N. A. Searcy, secretary. The concern has quarters at 187–189 Ross avenue, Dallas, which is now one of the most active electrical centres of the South.

WESTERN NOTES.

Edison-Lalande Fan Motors.—The Ansonia Electric Company carry a large stock of Edison fan motors in two sizes, seven and nine inch, with Edison-Lalande batteries suitable to operate them. The seven inch outfit is complete with chemicals sufficient to run the motor for 70 hours continuously and the nine inch outfit to run the motor for 100 hours continuously. The capacity of the batteries may be used up by continuous service or they may be used intermittently over a period of many months, as the batteries do not waste their strength while remaining idle. This concern constantly carries a large stock of all types of the Edison-Lalande batteries and repairs for them. In fact, their stock is probably larger than any other outside of the factory.

The Electric Appliance Company are preparing to distribute to their Western trade their new catalogue of Whitney voltmeters, ammeters, indicators, etc., calling particular attention to their new alternating instruments which are exciting considerable interest among the trade. Particular attention is called to the portable alternating ammeters. Heretofore accurate quantity measurements of alternating currents have required the use of a dynamometer, but the Whitney Company have produced an ammeter reading to one-twentieth of an ampere and absolutely accurate. The Electric Appliance Company are enjoying a splendid run on these instruments.

The Star Electric Lamp Company claim that the new Sunbeam incandescent lamp, which is being manufactured by the Star Electric Lamp Company is proving much superior to the old vacuum lamps. The gas uniting with the carbon when incandescent, prevents the drop of c. p. which was unavoidable in the old style of lamp and maintains the lamp at full initial c. p. throughout its life. Orders are coming in in increasing quantities, showing that the electrical fraternity appreciate the successful efforts of the Star Electric Lamp Company to supply an entirely new incandescent lamp that really marks a step in advance in the art.

The Garton-Daniels Electric Company, of Keokuk, Ia., manufacturers of the Garton lightning arrester, write us that they are enjoying a splendid sale for their specialty. They are hearing from all parts of the country of the good work done by the Garton arrester, and have many testimonials from electricians as to its efficiency.

NEW ENGLAND NOTES.

The Whitney Electrical Instrument Company, of Boston, have recently circulated their new catalogue containing a complete list of all their well-known voltmeters, ammeters and indicators. Besides their well-known instruments for continuous currents, they illustrate in this catalogue for the first time their new direct-reading voltmeters and ammeters for alternating currents, which have already achieved quite a marked success. These instruments are designed to be used on alternating currents, but they may also be used on continuous currents, where only approximate readings are required, and it is worthy of notice that any change in the number of alternations does not affect the readings. Like the instruments for continuous currents, they are constructed with the mechanical "Dead Beat" attachment to facilitate the taking of readings when used as portable or test instruments, and to assist in taking a mean reading where there is a constantly changing pressure or a variable current. The dials are calibrated by hand, with the greatest care. The pivots which rest in jewel bearings, are of hardened steel, ground and highly polished, thus rendering the instruments extremely sensitive. All parts are made to gauge and are interchangeable, so that in case of any injury to the instrument repairs can be made on very short notice, and at comparatively small expense. These instruments being direct-reading, no multiplying constant is necessary, except in cases where voltmeters of very high range are desired.

The Edison Electric Illuminating Company, of Boston, have issued a circular to their patrons offering to lease to them, at a slight expense, electric fans for summer use. The price for these fans will be $2.06 per month, and does not include the cost of current for running them, which will be registered on the meter in the usual way. This does not preclude the buyer from purchasing fan motors at the ordinary price of about $25.00 but brings within reach a cool breeze to all to whom the outlay for a complete fan may seem too large.

The Hawks' Electric Company, of Boston, have just completed the installation for one of the new factories of the Washburn and Moen Manufacturing Company, at Quinsigamond, near Worcester, Mass., comprising about 900 incandescent lights. They are also completing the equipment of the Agricultural College, at Durham, N. H. The Hawks' street fixtures for incandescent street lighting have proved very successful, and the company are selling large quantities of them to electric light companies using the incandescent system as a means of illuminating the streets.

The Pettingell-Andrews' Company, of Boston, have just received a contract from the Knox Gas and Electric Company, of Rockland, Me., for a large quantity of their well-known O. K. wire. The order comprises about 27,000 feet of varied sizes for incandescent mains. The Pettingell-Andrews' Company are now advertising by circulars "Coney Island" breezes at very reasonable rates, in the shape of Lundell fan motors for which they are getting large orders; one order alone coming in this week for over 200.

Salamander Wire. The Washburn & Moen Company's "Salamander" wire, appears to be attracting attention in Europe. A test of it has recently been made at the Allgemeine Elektricitaets Gesellschaft Laboratory by Herr Von Dolivo-Dobrowolsky, before several prominent German electricians, and in a variety of ways. Mr. C. T. Snedekor, the inventor, was present.

The Shawmut Fuse Wire Co. has been compelled by the recent fire in its office and factory to remove its office temporarily to 85 Water street, and its factory and storeroom to 54 Pearl street. There will be no delay whatever in filling orders.

PHILADELPHIA NOTES.

The Edison Electric Light Company, of Philadelphia, has made a contract with Otis Bros. & Company for two direct-connected electric freight elevators for the Samson street station. These elevators will lift 8,000 pounds at a speed of 150 feet per minute, and they will probably be among the largest of the kind.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

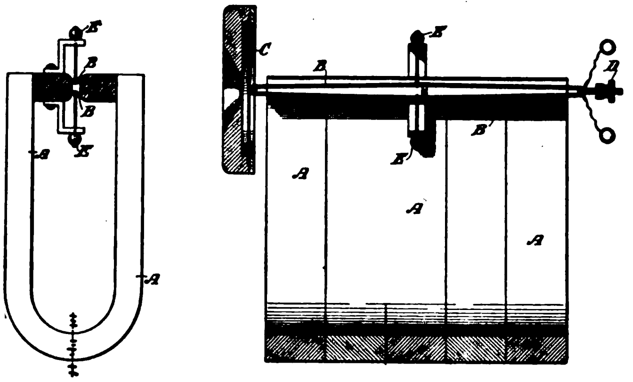
THE
Electrical Engineer.

Vol. XV. JUNE 14, 1893. No. 267.

FIELD'S BIFILAR TELEPHONE.

IN a recent patent issued to Mr. Stephen D. Field, that able inventor describes a type of telephone which embodies a number of novel and interesting features. Recognizing that the degree of polarization to which the ordinary magneto transmitter can be carried is limited by the necessarily small amount of iron in the armature, that is, the diaphragm, Mr. Field employs a method by which a very intense magnetic field can be employed in the transmission of speech.

The accompanying engravings, Figs. 1 and 2, show the new telephone in end elevation and in sectional side view. The diaphragm C is composed of some non-magnetic material to which is mechanically attached a bifilar circuit, B B, so arranged as to cut the lines of force of a very intense magnetic field. It is evident that the wires of this bifilar circuit may be as long as desired and hence be subjected to any desired degree of polarization.



FIGS. 1 AND 2.—FIELD'S NEW BIFILAR TELEPHONE.

Under ordinary conditions a bifilar suspension of this kind would possess a distinct period of vibration of its own, but as, for this purpose, it must respond to all rates of vibration, Mr. Field has introduced what he terms an "inharmonious spring" in the shape of two spheres of rubber, E E, which keep the vibrating loop in a state of continual stress. By the adoption of a loop, the conductor is given a bifilar character so that the currents flow in opposite directions in the two opposite sides and assist each other by mutual induction, thus counteracting the choking effect of self-induction and permitting the currents to flow with much greater freedom. By means of the system of suspension illustrated, the conductor becomes an inharmonious vibrator which will respond to vibrations of any character produced in the diaphragm, and the conductor being normally in a condition of mechanical stress is ready to respond instantly to any vibration communicated to it.

The employment of the dense magnetic field, the almost total absence of self-induction and the small inertia of the parts combine to give most excellent results in clearness and volume of transmission.

Mr. Field has also devised a number of modifications of of this type of instrument, among them one in which the bifilar loop is stretched in the multipolar field created by a series of magnets placed side by side, whose poles are alternately reversed.

A NEW TYPE OF ELECTRIC AND MAGNETIC INSTRUMENTS.

G. QUINCKE in the *Annalen der Physik und Chemie*, No. 1, 1893, describes, by the aid of diagrams, some galvanometers and magnetometers, which possess many novel features, constituting distinct departures from those types which are most generally known. A glass disc appears to be the most striking or essential portion of the apparatus. It is supported in a vertical position, and around the rim wires are clamped, whilst a mirror, fitted with a small magnet, is suspended in a hole at the centre of the disc. As thus arranged, the apparatus is capable of being used either as a tangent galvanometer or as a magnetometer. Movable coils may be placed on each side of the glass disc. The apparatus appears to be of a remarkably simple character, and this quality will commend it to instructors or demonstrators in physical laboratories who desire accuracy combined with economy in their instruments. Extreme accuracy is one of the qualities upon which Quincke lays special stress. He maintains that better readings can be obtained with his instruments than with those of the conventional type.

TOWING BY MAGNETIC ADHESION.[1]

ONE of the methods employed in France of towing vessels on the rivers and canals consists in sinking a chain at the bottom of the river, anchored up stream, which passes over drums of the towing vessel. These drums are set in rotation by the engines of the towing vessel which is thus hauled along, the chain cable passing over the bow and stern of the vessel. This method of towing is more particularly applicable where the currents are strong. In order to obtain the necessary grip upon the tow chain, it has heretofore been necessary to pass this chain over a series of grooved pulleys; but experience has shown that with this arrangement the chain is frequently ruptured, causing interruption in traffic. In order to avoid this, M. Debovet conceived the idea of obtaining the necessary frictional adherence between the winding drum and the chain by magnetism, and there has been recently constructed for the Compagnie de Touage de la Basse Seine et de l'Oise a vessel in which this plan is carried out.

The vessel, called the "Ampere," is 33 metres long, five metres breadth of beam, and is shown in plan and in section in the accompanying engraving. The boat is also arranged for direct towing in the ordinary way, for which purpose it is supplied with a screw and engines of 150 h. p. running at 100 revolutions per minute. When employed in working up stream, however, the engine is connected to the winding drum by bevel gears and runs at 90 revolutions per minute, developing 62.80 h. p.

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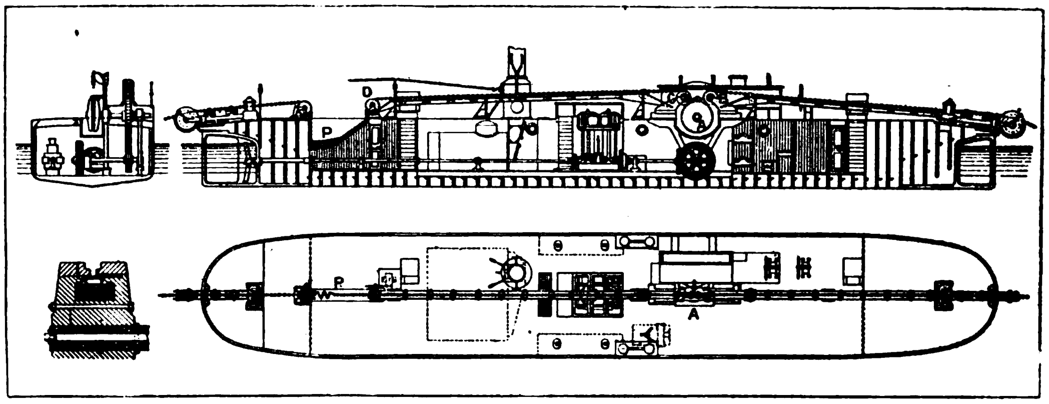
[1] E. Hospitalier in *La Nature*.

The chain passes over the bow, around the towing pulley A, and is guided by a non-magnetic guide pulley B, and passes out over guide pulley C. The latter is very massive, and is made of iron for the reason that if at that point the guide wheel is put in contact it gives to the magnetic lines of force an easier passage than that offered by the chain, and the latter no longer serving to close the magnetic circuit, releases itself more easily under the action of the weak tension of the slack towards the rear. A finger of non-metallic metal is arranged above the pulley A so as to make sure of the disengagement of the chain.

In this method of towing it is sometimes necessary to be able to control the paying out of the chain at the stern of the vessel, and for that purpose, after passing over the grip pulley A, part of the chain is deposited loosely in the pit P provided for that purpose; keeping it there when there is sufficient slack and paying it out again when more slack is needed. The paying out chain at the rear of the vessel is therefore also magnetized like the towing pulley, but not so strongly, as the brakeing effort is far less than is required for traction.

When the chain has little slack, the action of the pulley C is insufficient to produce the disengagement of the chain from the main pulley A, and then by magnetizing the pulley D, it assists the pulley C in pulling off the chain from the main driving pulley.



Magnetic Adhesion Towing Steamer on the Seine, France.

The construction of the magnetic pulley is shown in section in the lower left hand corner of the engraving. The magnetic friction being a function for the intensity of the current, it is evident that the frictional force can be regulated to a nicety, and sudden strains put upon the chain merely allow it to slip a trifle without causing rupture.

RESISTANCE OF MERCURY.

MM. Kreichgauer and Jager have published their researches on the thermic variation of the resistance of mercury. Their results give a formula very nearly approaching that of M. Guillaume, presented to the Academie on September 12, 1892. M. Guillaume has shown that the two are more nearly in accord than even seems at first sight. The new coefficient x is 0.0008884; it differs by $\frac{1}{3000}$ only from that of M. Guillaume, and this is the more remarkable in that the measurements were made with mercury purified by different processes, contained in glass vessels of different composition. M. Guillaume made his tests by two methods derived from that of the Wheatstone bridge, while at Berlin the crossed shunt was used. The French experimentalist used Benoit contacts, modified; the German standardizers used contacts soldered into the glass. The agreement of the results after the great number of tests made shows that confidence may be given to mercury standards under proper restrictions.

THE JOEL ALTERNATING MOTOR.

For some time past Messrs. H. F. Joel & Co., of London, have been building alternating motors for small powers. These are constructed like direct-current motors except that the fields are laminated, carbon brushes are employed and the armature has notches in it. According to the belief of *Industries* the fields are wound with two circuits, the primary being connected to the terminals, and the secondary to the armature. The machine appears to have been the result of a good deal of experimental work. In another motor for very small powers, the fields are built up not of punchings, but of a wire which is first coiled, the coils then being molded by pressure into the required forms. The armature, of the Pacinotti form, is made in the same way. The motors are said to be rapidly coming into use for operating hoists and similar work, where a large starting torque is needed.

THE BOUDREAUX ANTI-FRICTION BRUSH.

A new anti-friction brush intended for dynamo and motor service has recently been brought out by L. Boudreaux, of Paris. The brushes of this type are composed of laminated metallic sheets of excessive thinness bent upon each other, and pressed to the dimensions of the brush. The metal employed has copper as a base, is very malleable and possesses anti-friction qualities in a high degree. Each millimetre of section contains nearly 40 laminations each of a thickness of between two and three hundredths of a millimetre. Owing to this extreme subdivision of the metal there results a softness of contact which reduces the wear on the commutator to a minimum, and at the same time insures long life to the brush. For equal dimensions, the weight of these new brushes is twice as great as that of the ordinary laminated copper brushes, from which it follows that their conductivity is considerably higher; as a result there is considerably less resistance and heating at this vital point. This is an especially valuable feature in machines generating heavy currents at low tension. Experiments have shown the superiority of these brushes on machines delivering 1500 amperes at two volts.

NEW METHOD OF ALUMINUM PLATING.

It is claimed that the drawbacks attending the inability of gilding and plating on aluminum have been entirely removed by the invention of Dr. G. Lehnert. By means of his method, aluminum may now be gilded and plated either by galvanic deposit, in the same manner as is adopted for other metals, or by direct application and heat. To accomplish this, the aluminum to be treated has to be covered with a special metallic film, after which the other manipulations are effected in the usual way of galvanic depositing.

REMINISCENCES OF SIR JAMES ANDERSON.

BY

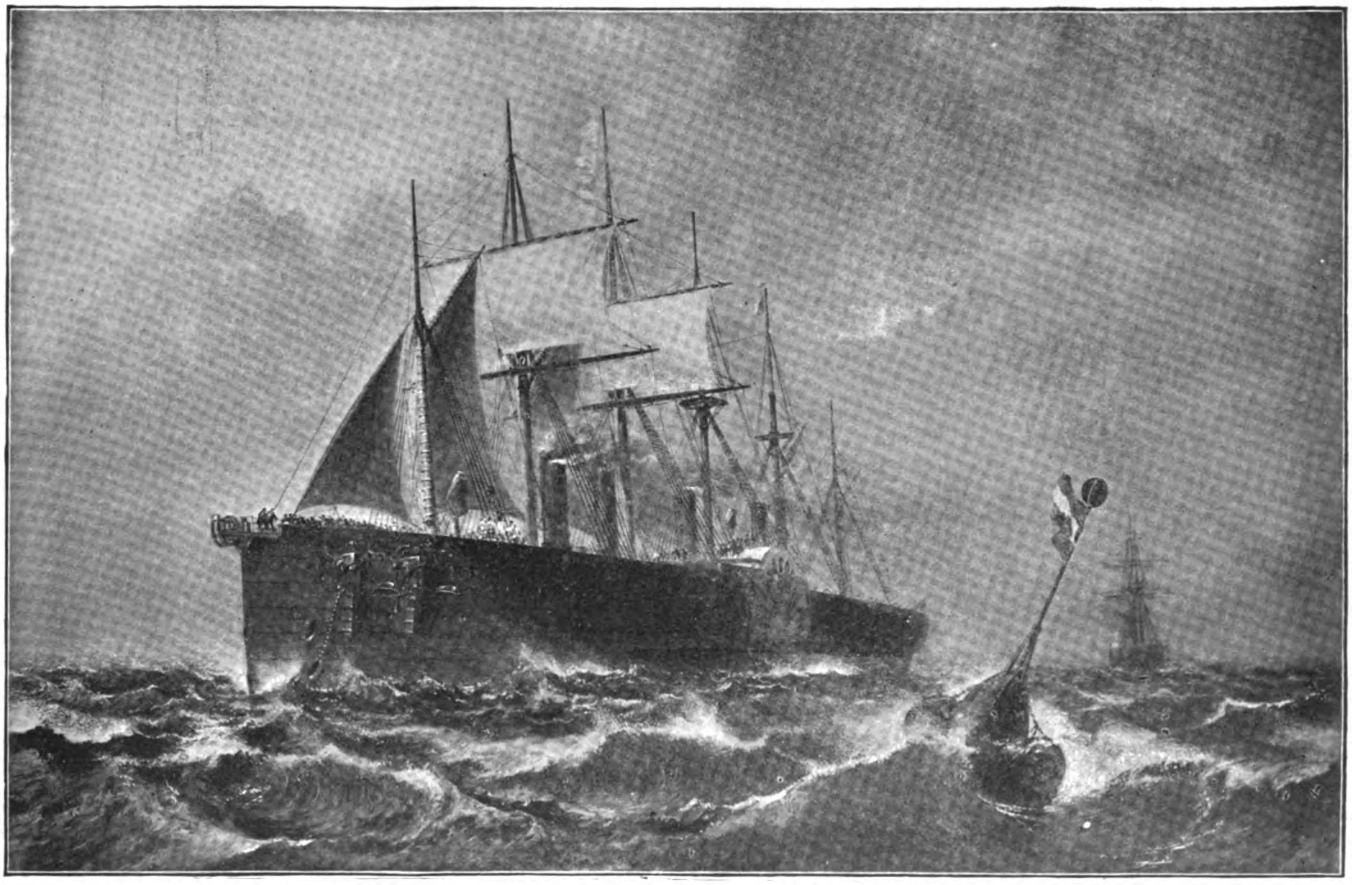
A. E. Kennelly

Sir James Anderson.

THE announcement of the death of Sir James Anderson, in London, on the 7th ult., must have been everywhere met with unfeigned regret. Sir James Anderson was born in 1824 at Dumfries in Scotland. He showed early a strong inclination for an active life, and went to sea as apprentice in the merchant service in 1840. In 1851 he entered the Cunard Company's service, and commanded their ships for several years. After the failure of the first Atlantic cable in 1859, and when a new company was formed in 1864 for the purpose of laying another cable with the aid of the S. S. "Great Eastern," the chairman applied to the Cunard company for the services of a commander in whose skill and ability they could place absolute confidence. In compliance with that request, Captain Anderson commanded the "Great Eastern" during the 1865 expedition.

After the cable unfortunately parted in deep water during paying out, and after several unsuccessful attempts had been made to recover it, the "Great Eastern" returned to England, with the hopes of the enterprise almost abandoned, and with its capital generally supposed to be lost in the sea. It was in a great measure due to the firmness of Captain Anderson, and his earnest conviction of ultimate success, that the directors regained courage, and raised among themselves the money for a new cable. It is well known how in 1866, Captain Anderson again took the "Great Eastern" over the Atlantic, this time successfully laying the metal thread between the old and new worlds, and how, this done, the 1865 cable was also safely recovered the same Autumn in midocean, a task then almost undreamt of. It was respliced, and also landed finally on the American shore. For his services on this eventful occasion Captain Anderson received the honor of knighthood.

Resigning his post in the Cunard service, Sir James Anderson devoted himself entirely to submarine telegraphy, with whose development his name has become so thoroughly identified. Director in nearly all the submarine cable companies existing, he was the managing director of the Eastern Telegraph Company, whose cables spread from England to India and ramify throughout the Mediterranean Sea. He was also Managing Director of the associated African cable companies whose lines engird the dark continent. To these enterprises he gave his entire attention with an earnestness and devotion that were characteristic



"The GREAT EASTERN, having grappled the lost cable of 1865 three times, getting it from the bottom ¾ of a mile, ¾ and ½ a mile, in the several attempts, finds her tackling exhausted, steers homeward, a gale springing up, and night coming on—August 12th, 1865."—JAMES ANDERSON.

THE "GREAT EASTERN" UNDER COMMAND OF CAPT. ANDERSON, CABLE GRAPPLING, 1865.

of the man. Messages from any of the hundred telegraph cable stations in that wide-spread electric union came to him at all hours of the day and were brought to his house by messengers at night.

Many a man, far down the African coast, felt his tasks lighten, and his difficulties less beset, under the consciousness of that everwatchfulness of the chief who was always within an hour's hail. Even when Sir James Anderson revisited Dumfries, as he usually did each year, this attention was scarcely less vigilant, and the orders for station, and directing the movements of a small fleet of cable steamers, would issue from Dumfries almost as uninterruptedly as from the London office,

The devotion to duty and earnestness of purpose which are the qualities so revered by sailors, were preëminently characteristic of Sir James Anderson. That firmness and energy he infused into all who came in contact with him.

Courteous and forbearing, of fine presence and dignified mien, he impressed with respect all whom he met. The accompanying engraving is from an excellent photograph taken not long since.

He added to great administrative ability, that keen insight and grasp of facts and events that so often distinguishes the trained legal mind. Everything that he wrote, said, or did, carried the impression of careful accuracy. The book and papers that he has written on submarine telegraphy are justly authoritative, on that account especially.

Of strong frame, and with a constitution that had never given way to a day's illness, he felt very keenly the loss of his wife, Lady Anderson, in September, 1891. From that blow he never recovered, and his health began to fail visibly in the year following, although no apprehensions were at that time entertained for his life.

To all who have ever met him, his memory will usher in regret. By his colleagues, in particular, his loss will be most keenly felt. But to all who served under him, scattered over sea and land, the tidings of his death will bring heartfelt sorrow. Their welfare had been so long his care, their work his pride, their united success his ambition. As one of those who served under him for several years, one whose fortune it was to see him frequently and know him well, the writer desires to add his personal tribute of sorrow and esteem.

We are indebted to Mr. George G. Ward, vice-president of the Commercial Cable Company, for the accompanying picture of the "Great Eastern" which, we think, will fitly accompany Mr. Kennelly's interesting notes. The inscription under the picture was placed under an original for Mr. Ward by Sir James, who was his personal friend. Mr. Kennelly has told how Sir James Anderson's efforts and perseverance resulted in success a little later than the discouraging episode illustrated in the engraving.

A NEW METHOD OF ELECTRIC HEATING.

In the June number of the *Consular Reports*, Consul-General Frank H. Mason, of Frankfort-on-the-Main, gives an account of a new process for heating, melting and refining metals electrically. The invention is the joint work of Messrs. Lagrange and Hoho, of Brussels, Belgium, and is carried out in a very simple manner.

The apparatus consists of a glass or porcelain vase, which may be of any size conveniently adapted to the purpose, provided with a lining of lead connected with the positive pole. The vase is filled to three-fourths its capacity with acidified water. A pair of iron tongs with insulated handles is attached by a flexible conductor to the negative pole of the dynamo. With this simple and inexpensive equipment the following phenomenon is produced.

The electrical current having been switched on, a bar of wrought iron or other metal is taken up with the tongs and plunged into the water within the vase. Immediately the water begins to boil at the point of contact; the immersed portion of the iron rises quickly to a red, then to a white heat, and emits a stream of brilliant white light. In a few moments the heat becomes so intense that the iron melts and falls off in bubbles and sparks, leaving a clear, glowing surface in perfect condition for welding. The heating process has been so rapid that neither the water nor the end of the bar held within the tongs have been more than slightly warmed, and, the current being switched off, the bar, with its submerged end glowing, may be readily held in the naked hand. If, instead of a bar of metal, a stick of carbon is used, the heat in a few minutes produces detached fragments of amorphous carbon, which proves scientifically that a temperature of 4,000 degrees Celsius has been developed. The rapidity of the heating and the limit of temperature to be reached are easily and accurately governed by the strength of the current employed, so that the whole process is under the absolute control of the operator. During recent experiments at Berlin the measuring instruments registered a tension of 120 volts and a current of 220 amperes. It was estimated that fully 50 per cent. of the current was directly utilized as heat, whereas the practical limit of such utility has not hitherto exceeded 20 per cent. It is stated by the inventors that by employing a still stronger current a temperature of 8,000 degrees Celsius has been developed.

The action here noted is explained as follows by the inventors: The current passing into the water, decomposes the latter into its two gaseous elements—oxygen and hydrogen. The oxygen is attracted and gathered on the relatively large surface of the lead lining and produces no noticeable effect. The hydrogen, on the other hand, gathers around the immersed portion of the bar; and, as this has a comparatively limited surface area, it is immediately surrounded with a close envelope or jacket of hydrogen, which, being a bad conductor of electricity, creates a powerful resistance to the passage of the current and thus develops the heat which causes the bar to glow and melt.

For welding purposes the process is pronounced perfect. The clean envelope of hydrogen which surrounds the heated metal prevents oxidation, and the welding surface is left free from the effects of sulphur and other impurities, which are always present when iron is heated by a coal fire in an ordinary forge. The quality which entails the largest possibilities, and which has been as yet only superficially investigated, is the capacity of this process to heat quickly and to any desired temperature the end or submerged surface of a mass of iron while the remainder of the mass is left cool and comparatively unaffected by the heat.

At Essen, Messrs. Krupp & Co. are experimenting with it in the hardening of steel cannon; and it is believed that in chemistry this method of producing an intense and easily regulated temperature may lead to the successful manufacture of diamonds, rubies and sapphires through the production of the larger forms of crystalized carbon.

THE SIEMENS-HALSKE CONDUIT ROAD AT BUDA-PEST.

Mr. Edward P. T. Hammond, U. S. Consul at Buda-Pest, writes as follows, in regard to the electric street railway in that city, in his report to the State Department:

The Siemens-Halske electric conduit railway system was introduced into Buda-Pest three years ago and is now in operation on nearly seven miles of double-tracked road. Sixty cars, each with a seating capacity for 32 persons, are run over the line at an average speed of 12 miles an hour.

The service has been exceedingly satisfactory to the public, the only short interruptions having been caused on a few occasions by unusually heavy falls of snow. The rate of speed could easily be doubled, but municipal regulations forbid any increase.

The fare charged varies from 2½ to 4 cents, according to the distance. Transfer tickets are issued for 4 cents.

The company operating the road has obtained concessions for an extension of about three miles over some of the principal streets, and further concessions will probably be secured.

The following facts in relation to the construction and equipment of the railway were furnished by parties in this city (the company publishing no reports): Cost of road bed (rails, excavating, masonry, paving and switches), about $2,880 per mile of single track; cost of cars, including motors, $6,000 each; weight of cars, including motor, five tons; cost of buildings, $15,000; five boilers, with grates and masonry, $20,000; machinery (engines, dynamos, switchboard, etc.), $70,000; cost of running one car per mile (maintenance of track, labor at power station, fuel, employees on cars, etc.), 5½ cents.

Some of these figures, especially those relating to cost of road-bed, appear to us to be decidedly low, even taking into account the lower general cost of material and labor abroad.

AN UNDERGROUND ELECTRIC ROAD FOR PARIS.

The conditions for an underground electric road are more favorable in Paris than in New York, and the project appears, therefore, to have taken definite shape in Paris. The projected underground electric railway to unite the Bois de Boulogne and the Bois de Vincennes, is to consist of a circular cast-iron tube 20 feet in diameter and seven miles long, in which will be laid a double track. Trains of four cars will be run on each track at intervals of two minutes. Stoppages will be made at 17 stations, and the whole distance from one terminus to the other will be traversed in about forty-five minutes. Steam engines of 4,000 h. p. will generate current for light and power.

WORLD'S FAIR DEPARTMENT.

THE MOVABLE SIDEWALK AT THE WORLD'S FAIR.

When the long steamboat pier running out into Lake Michigan from the east front of the Casino was built some means had to be devised for conveying passengers from the boats to the grounds, as the walk from one end of the pier to the other is no small matter when the day is warm. Realizing that this was an excellent opportunity of exhibiting their system the Multiple Speed and Traction Railway Company sought and obtained a concession allowing them to build a continuous movable sidewalk the length of the pier, having a loop at either end and entrance and exit gates at convenient points along its length. The walk moves continuously in one direction and is divided into two longitudinal sections, one moving at the rate of three miles and the other, upon which seats are placed, at six miles an hour, so that one merely steps from the stationary platform to the slower of the moving ones and from this to the faster where the passenger takes his seat and is carried as far as he wishes. He then steps off in the same way, without shock, as the relative movement of the sections is so slight that the most timid person has no difficulty in stepping from one to the other while in motion.

The track, a plan of which is shown in Fig. 1, is elevated a few feet above the level of the pier and surrounded by a broad walk bounded by a railing. The movable platforms are covered by a wide roof supported by centre posts. In Fig. 3 is shown a sectional and a plan view of one of the three-mile trucks carrying two motors. Every thirty-fifth truck is thus equipped and is built of steel instead of wood. All the trucks are connected, one with another, by drawheads, and each section of platform has a thin sheet-iron extension projecting over the edge of the next and wide enough to cover the spaces between when rounding the curves at the loops. A continuous moving floor is thus maintained at all times. The trucks are 12 feet 6 inches long over all, and have a wheel base of five feet nine inches. The gauge of the track is 45 inches, and the wheels, four to each truck are of cast iron, with chilled treads 18 inches in diameter shrunk on light axles with journals $1\frac{1}{8}$ by 4 inches. The platform, carried by the projecting part of the frame, as shown, is 36 inches wide and of such a height as to just clear the stationary walk over which it laps a few inches, and is provided with a strip of rubber tacked upon its edge to cover the small vertical distance between the two.

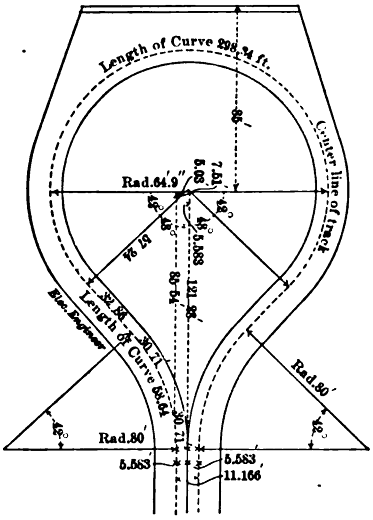


Fig. 1.—Plan of Track, Moving Sidewalk.

The upper, or six mile platform is composed of a series of trucks 12 feet 6 inches over all in length like the others but boarded over their entire width, 5 feet 10 inches, and upon this floor transverse seats are placed, Fig. 4. This platform laps over the slower one as the latter does over the stationary walk, and a space is left between the edge and the ends of the seats that passengers may move readily from one to another.

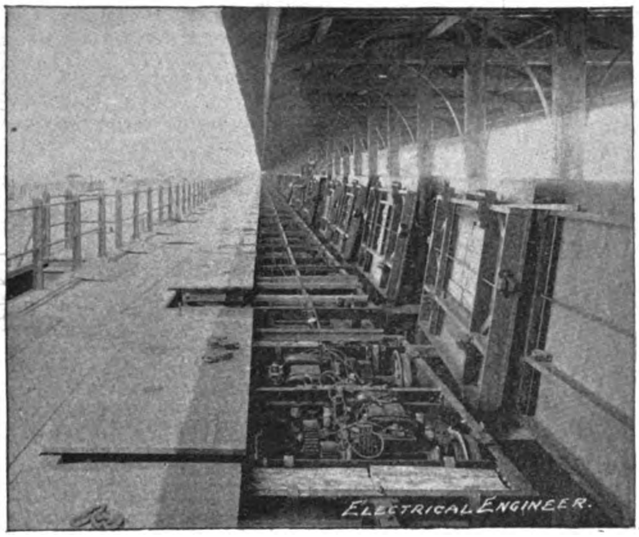


Fig. 2.—Perspective View: Tops of Motor Trucks Removed.

The method of propelling this upper platform constitutes the main feature of the system. As will be seen from Fig. 6, it is carried upon two rails resting upon the tops of the wheels of the trucks. These rails, 4 inches deep and $\frac{1}{2}$ inch thick are simple flat bands of steel, flexible and endless. They consist of pieces welded into lengths of 130 feet each, which are riveted together by means of close-fitting machine-made joints. Fastened to the under side of the upper platform are brackets in each of which is placed a block of rubber to serve as a spring, and bearing upon this is a shoe made of case-hardened steel, fitting loosely over the rail and sliding upon it as the cars enter and leave the curves. It was found that the expansion and contraction due to changes of temperature is only sufficient to cause a lateral movement of the rails over the treads of the wheels upon which they rest of about one inch, so this has been provided for by having about $1\frac{1}{2}$ inches play between the rails and the wheel flanges. We believe this is the only instance on record of a piece of steel 4,300 feet long without any expansion joint whatsoever. The draw heads between the upper cars simply keep them properly spaced, for, of course, there is no tension upon them due to traction as in the case of the lower trucks, and the upper platform moves as a unit at exactly twice the speed of the lower under all conditions, as its speed is equal to that of the periphery of the wheels while the speed of the trucks equals that of the axles.

The electrical equipment consists of 20 "G, 30" four-pole

General Electric double reduction motors rated at 15 h. p. each, two of which are placed on each of the ten motor trucks. The trolley wire is strung on special oil insulators under the platform at a level with the fixed rails on which the trucks run, and the arm extends downward from the overhang of the slow platform so that the trolley bears upon the upper, instead of the lower side of the wire, Fig. 5.

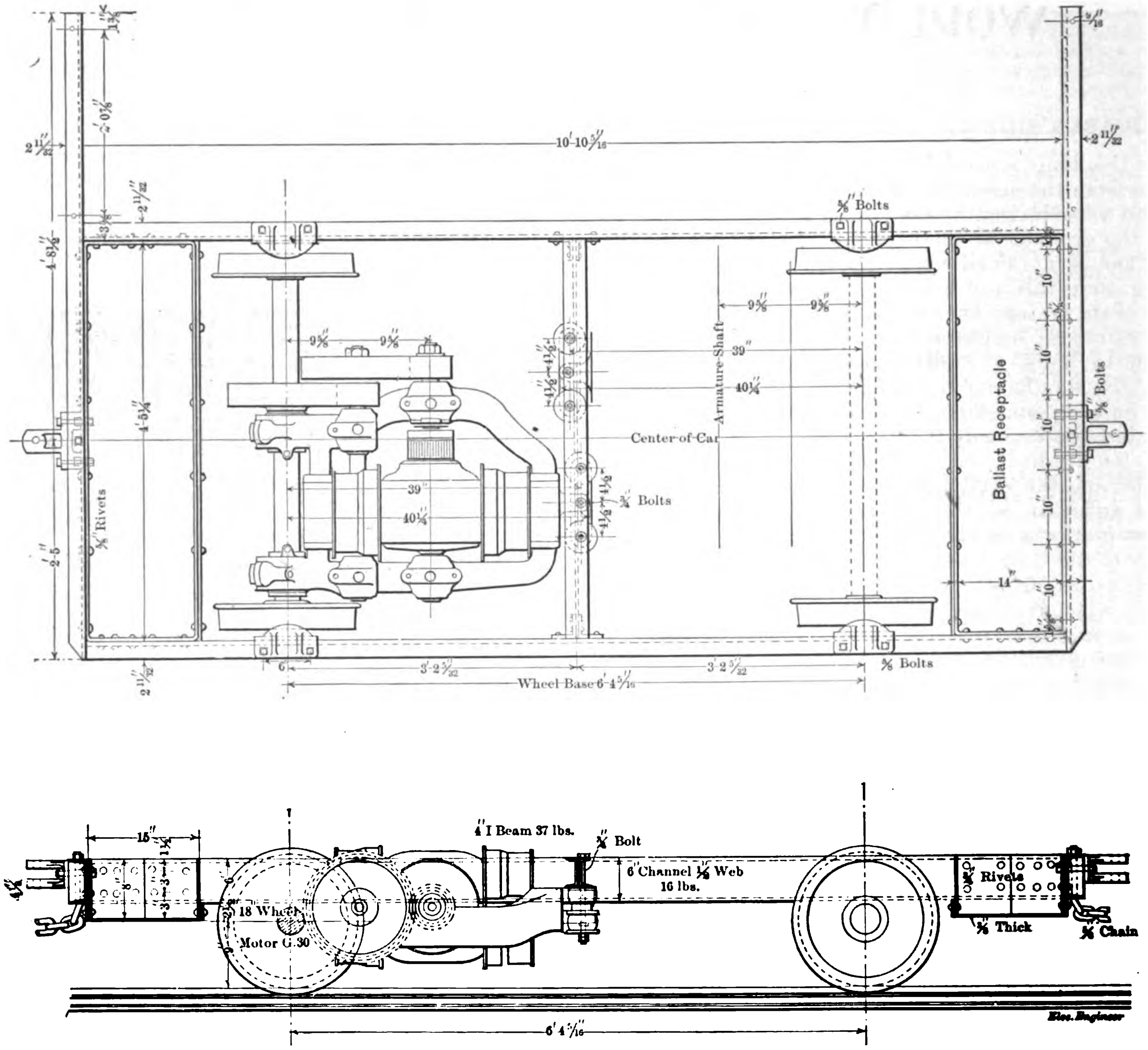


FIG. 3.—MOTOR TRUCK OF THE MOVING SIDEWALK.

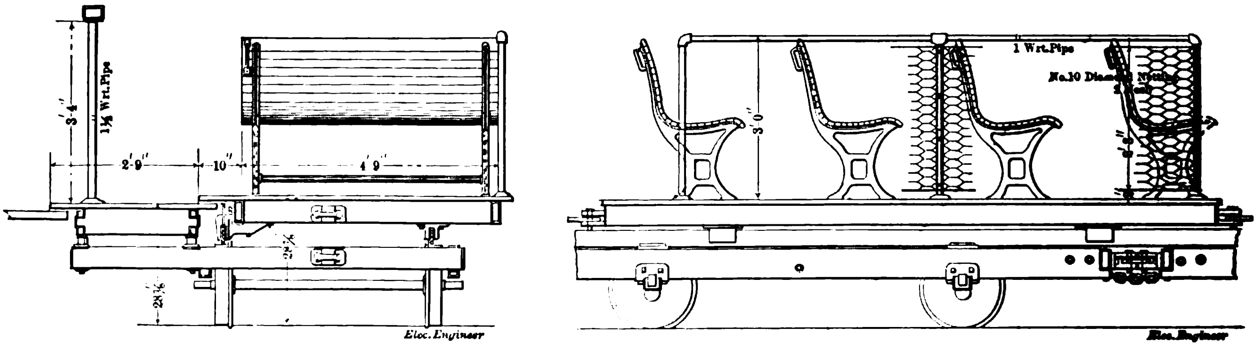


FIG. 4.—FAST PLATFORM WITH SEATS.

The current is rented from the Exposition Company and is generated in Machinery Hall. An interesting feature of the construction is the arrangement of the return circuit. Instead of bonding the rails and grounding the track at intervals, the endless flexible rail is made to carry the current back to a fixed point, near that at which the feeder is tapped into the trolley wire. Thence it passes through the wheels to one of the fixed rail sections and thence back to the generator. The flexible rail is, of course, much larger than the current flowing through it requires and is found to answer the purpose admirably.

To guard against accidents an automatic electro-mechanical cut-out has been placed in the main circuit and at intervals of 30 feet throughout the length of the track are bell circuits and push buttons, by means of which the entire "train" can be almost instantly stopped, the upper platform and endless rails taking the place of a brake the instant the power is cut off.

The seating capacity of the road on the pier is 6,000 passengers at onetime and at a speed of six miles; 36,000 passengers will thus pass a given point in an hour. Considering that this is obtained from a 45-inch gauge, the capacity seems, indeed, marvelous. The trucks each weigh about 1,500 lbs. and the platforms 1,200 lbs. or a total of trucks and platforms each of 2,700 lbs. There are 340 of these, making a total weight of train of 918,000 lbs. The motor trucks, of which there are ten, weigh 12,000 lbs. each, thus making the total weight of the train 1,038,000 lbs. or 519 tons.

To propel this train, 300 electrical h. p. are provided as stated above, but from present indications it is not likely that over 200 h. p. will be required to run the entire train loaded with 6,000 passengers.

To sum up, the feat performed by this device is that 6,000 passengers—representing a dead load of 519 tons or only 173 lbs. per passenger—can be transported continuously by expending not more than 200 h. p.

It may safely be stated that no other known device of transportation offers advantages in motive power and the distribution of weights so extraordinary as this, and the results that will be obtained at the Exposition are deserving of the most careful attention of all who are interested in passenger transportation.

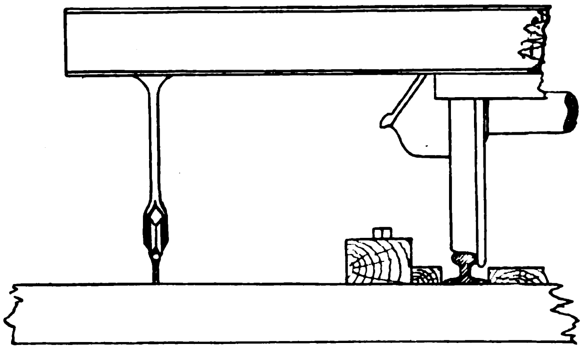


FIG. 5.—METHOD OF PICKING UP THE CURRENT.

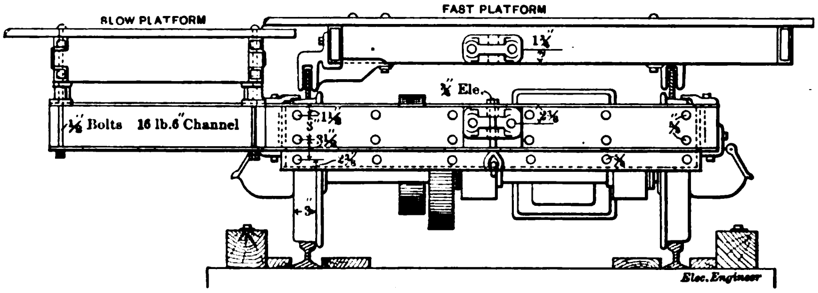


FIG. 6.—PLAN VIEW SHOWING RELATION BETWEEN THE TWO PLATFORMS.

J. H. BUNNELL & CO. AT THE WORLD'S FAIR.

THE description of the Government Naval Observatory exhibit at the World's Fair, which we give on page 574 in this issue, shows in a striking way the absolute dependency upon electricity of modern standard time determination and distribution. There is scarcely a step or operation in the cycle which is not controlled or actually effected by this means, and the instruments have now reached such a stage of perfection that improvement seems almost impossible.

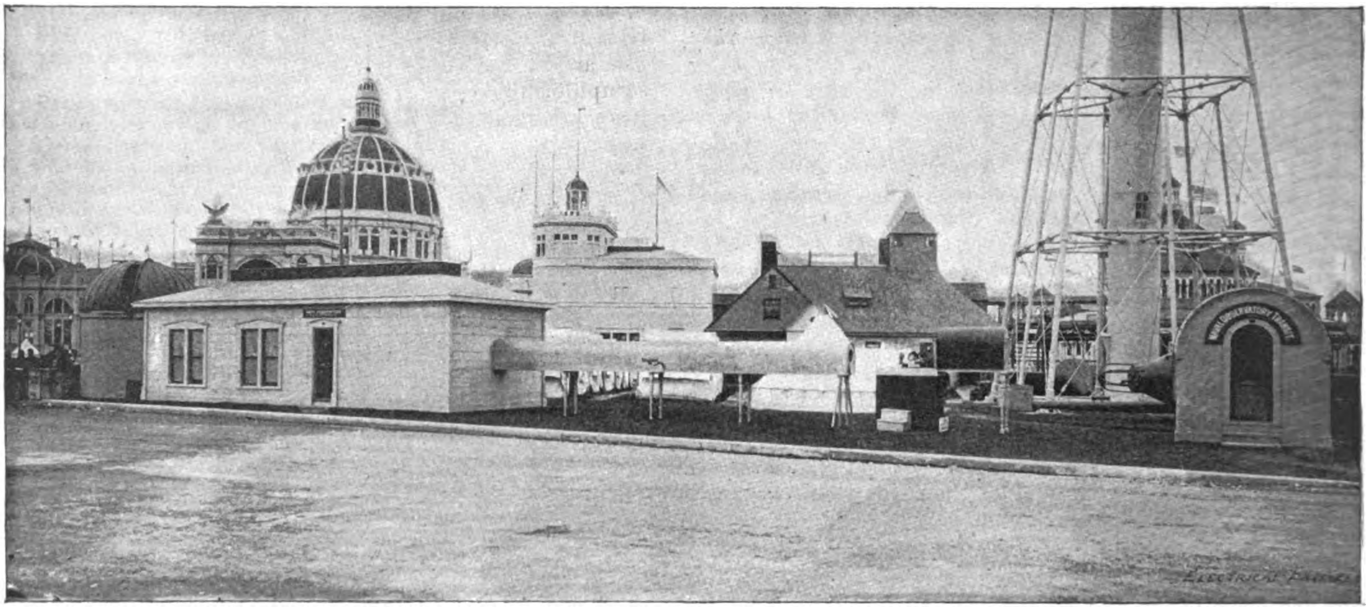
In the article above referred to, mention was made of the fact that all the electrical instruments employed were manufactured by Messrs. J. H. Bunnell & Co., of this city, but in addition to those specifically mentioned there are a number of others, all made by the same firm, which go to make up a most complete exhibit and the details of which are of value, especially to those interested in telegraphy and the transmission of signals generally. Among them are the following: 1. A Western Union standard tangent galvanometer handsomely mounted on a circular hard rubber base, 7⅜ inches in diameter, provided with leveling screws and anchoring points. The galvanometer consists of a magnetized needle ⅞ inch in length, suspended at the centre of a rubber ring six inches in diameter, containing five coils of the resistance, 0, 1, 10, 50 and 150 ohms. 2. A large testing set galvanometer and rheostat, consisting of a sensitive horizontal needle galvanometer with a magnifying reading lens, three coils of 0, 40, and 100 ohms resistance, and a combined Wheatstone bridge and rheostat covering all ranges of measurement direct from 100 to 11,000 ohms, and with a bridge having in each side coils of 10, 50, 100, 150 ohms, thus admitting of multiplying measurements up to 550,000 ohms. 3. Steel lever keys with legs, the especial feature being the very light and at the same time very strong steel lever, in one piece, 4. Legless steel lever keys, like the usual steel lever key, except that the legs are omitted and the connections made at binding posts so as to permit the key to be screwed down to the deck, or table from the top. 5. A new model open circuit combination set in which is used a transmitter operated by the key and actuated by the same local battery as that by which the relay actuates the receiving sounder. By this means the operator is enabled to hear his own transmission, and the transmission of the signals is not subject to the variable peculiarities of the hand on the key, as is the case when the transmission is direct by the key. In this way the work of the operator is better, because he can distinctly hear it, and the liability to imperfect contacts is greatly lessened. 6. A set of automatic repeaters for open circuits so arranged that the two sets of instruments constituting the complete repeater may be used at will either for repeating from one line to another, or as two separate sets of instruments, each one operating its own individual line independently. 7. A quadruplex pole changer arranged with adjustable contact springs, so placed that their operation shall be in plain front view of the operator for better convenience and accuracy of adjustment. 8. A pocket relay made with special view to the military telegraph service in temporary stations on railways, in accidents, etc. 9. Twenty ohm polar relays arranged for convenient manipulation of the magnet adjustments and also for powerful polarization. 10. Main line relays of 150 ohms resistance, in which the armature, which in this case is stamped out in one piece, gives the needed rigidity with much lighter weight of metal than would be required if otherwise put together. 11. Main line sounder relays of 150 ohms, with key on base. This is an entirely new form of main line instrument introduced this year which combines the sound-giving qualities of the best local sounders with the large fine wire magnets and special adjustments of a relay, and which, in practice, is said to give more than three times the volume of sound given by the best box relays. These are used for wrecking instruments, testing sets, field telegraphs, switchboard sets, temporary offices, and all places where it is desirable to dispense with the use of local batteries; they are made with full size relay magnets of 150 ohms resistance, having both magnet and armature adjustments. They are highly sensitive and give a clear working sound on circuits where, otherwise, a relay with a local sounder and battery would be necessary.

12. Resonating boxes on swinging arm in which the sounder is placed to amplify the sound, and to bring it as near as desired to the ear of the operator. 13. An improved form of standard local sounder with magnets larger than usual, together with sounding parts arranged in such manner as to produce fully efficient working sound with but one cell of local battery, instead of two. 14. Repeating sounders with spring contacts for repeating in direct Morse circuits. Repeating sounders arranged with four sets of contact springs simultaneously actuated by the sounder lever for the purposes of transmitting on four lines at the same moment, the signals used in sending time. This same form with a greater or less number of contact springs is adaptable for from one to six circuits. Giant sounders such as those generally used in railway and commercial telegraph service. 15. Ordinary circuit-preserving transmitters, and "Shovel Nose" transmitters for use with duplex and quadruplex telegraphs.

There is also shown a transmitting table upon which are placed for exhibition the instruments forming part of the Gardner system of time transmission.

COMMENDATION OF ELECTRICITY BUILDING.

THE *New York Times* has been doing some admirable work in connection with the World's Fair, in describing the exhibits; and its issue of June 10 contained a very full and interesting article on Electricity Building, the work done there by Prof. Barrett and Dr. Hornsby, and the nature of the exhibits. A good picture is also given of the building. Mention is also made in the article of the leading points and dates of electrical advance. Altogether, the article is a most creditable piece of work, and worthy a great, progressive metropolitan journal—such as the *Times* is.



U. S. Government Naval Observatory Exhibit, Chicago World's Fair.

THE GOVERNMENT TIME SERVICE AT THE NAVAL OBSERVATORY.

The Naval Observatory at the World's Fair, forming part of the Government exhibit, delightfully situated on the shore drive near where lies at anchor Uncle Sam's dread staff battle ship with her terrible staff guns, contains some of the most interesting electrical apparatus to be found within the grounds. The whole system of the Government time service in connection with the lines of the Western Union Telegraph Company is shown, and a description of some of the instruments employed to insure accuracy in the signals sent broadcast over the land, and also to maintain the perfect regulation of the chronometers used aboard ship and in the observatories cannot fail to be of interest. No less than 70,000 clocks are regulated by the master clock at Washington each day at noon, the signal traversing some 300,000 miles of wire, and all regular business of the Western Union Company is suspended during the time necessary for the transmission. At the same instant time balls are dropped at New York, Boston, Philadelphia, Newport, Wood's Holl, Baltimore, Washington, Fortress Monroe, Savannah, New Orleans, the World's Fair, and Havana, Cuba.

To determine the mean time two astronomical clocks are used in connection with a fixed transit telescope having several groups of cross-threads in its field. The transit of some group of stars rapidly crossing the meridian is observed each clear night and the times, as shown by the sidereal clock, recorded on an electric chronograph. This instrument consists of a cylinder making exactly one revolution a minute and covered with a sheet of paper upon which a helical line is traced by a pen slowly moved parallel with the axis, and carried by an arm the other end of which is fixed to the armature of an electromagnet actuated each second by the pendulum of the clock. Each second's beat is thus recorded by a movement of the pen to one side of the path in which it moves, and a consequent break is made in the line. The transits of the stars are recorded by similar breaks controlled by a key in the hand of the observer. After instrumental errors and those due to personal equation have been eliminated, the error of the clock is determined by the difference between its recorded time of transit and the right ascension of the star. The object of taking a group of stars is, that their mean may be taken and the liability of error lessened. The comparison between the mean time clock and the sidereal clock is made by connecting both with the chronograph simultaneously as shown in Fig. 1. The records made are shown in Figs. 2, 2A and 2B.

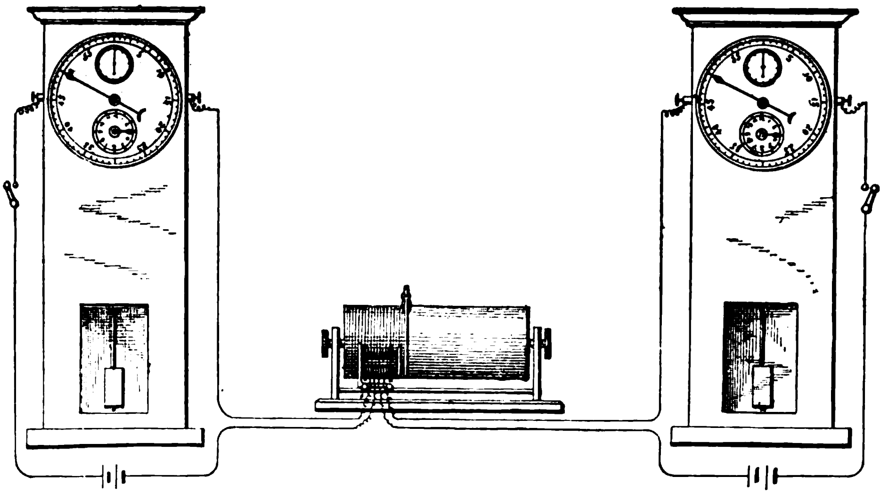


Fig. 1.—Mean Time and Transmitting Clocks.

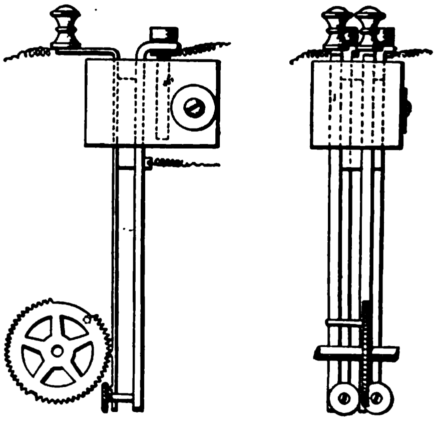


Fig. 3.—Circuit Breaker.

In the distribution of the true time use is made of a third or "transmitting" clock, the invention of Commander W. F. Gardner of the Naval Observatory. This clock, like the others, is as nearly perfect in its mechanism as it can possibly be made, and resembles them in all respects, except that the second hand pinion carries a wheel having teeth corresponding to the seconds against which bears a spring which opens a circuit each time it is lifted by a tooth. The 29th, 55th, 56th, 57th, 58th and 59th teeth are omitted as shown in Fig. 3, so that on the beats of the seconds corresponding no signal is given. The opening of the circuit releases the armature of a magnet, which closes the main and local lines and clock circuits of the Western Union throughout the country. Shortly before noon each day the transmitter is compared chronographically, set exactly right, and is then switched into circuit, Fig. 4, and allowed to send its second-beats until 11.59.50.

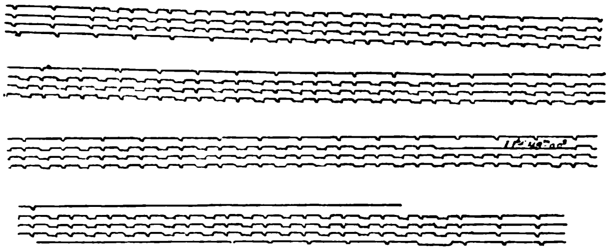


FIG. 2.—CHRONOGRAPHIC RECORD OF STANDARD CLOCK AND TRANSMITTER.

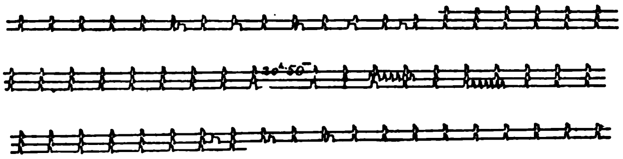


FIG. 2A.—CHRONOGRAPHIC RECORD OF OBSERVATION OF A STAR.

By a second contact spring on the inside of the clock, through which the current can be switched, the clock is made to send a signal only at the end of each minute. It should be observed that this break is longer than any of the others and lasts nearly a full second.

This is the last beat before the instant of noon, and the interval is employed for switching in the circuits operating time balls, gongs and other devices used to indicate the moment of noon. The noon beat, instead of being instantaneous, lasts a full second to insure the perfect working of electromagnetic time ball mechanisms.

The beats as they are sent out are recorded on the chronograph together with those of the standard clock and a record is kept of any error that may occur.

The method of testing chronometers previous to issue is also an interesting process. It is now required that each instrument shall be accompanied by an affidavit that all its parts are of American manufacture, since it has been satisfactorily proven that those fulfilling this condition are the best in the world. They are then subjected to six months' trial at all temperatures to which they will be subjected in use, and a record of their performance at each step is scrupulously kept. The temperature room, in which the tests are made, is heated by the circulation of hot water kept at any desired temperature by Bunsen burners the flow of gas to which is regulated by an electric thermostat; when a temperature lower than that of the surrounding air is required, the room is cooled by ice. The gas pipe has a valve normally held open by the pressure of a spring, as shown in Fig. 5, and is automatically closed at the proper moment by the action of the electromagnetic device, shown in Fig. 6, which is controlled by the thermostat. A very small jet of gas is kept continually burning over each Bunsen burner to relight it when the supply of gas, after having been stopped, is again turned on.

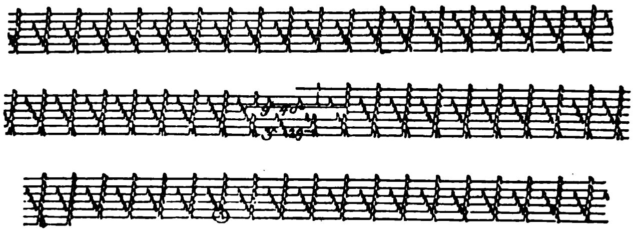


FIG. 2B.—CHRONOGRAPHIC COMPARISON OF MEAN TIME CLOCK WITH A SIDERIAL CLOCK.

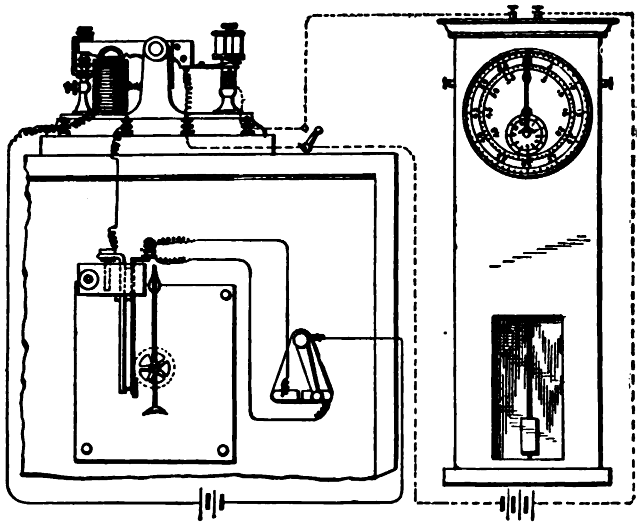


FIG. 4.—TRANSMITTING CLOCK WITH TELEGRAPHIC CONNECTION AND CORRECTING CLOCK IN CIRCUIT.

The thermostat consists of a glass tube like an ordinary thermometer with a spiral bulb, but open at the top and having a platinum wire passing through the bottom and in contact with the mercury. Another platinum wire leads into the open end of the tube, where it is held at any desired height, as shown in Fig. 7. On top of the column of mercury rests a drop of glycerine to prevent sparking and consequent oxidation.

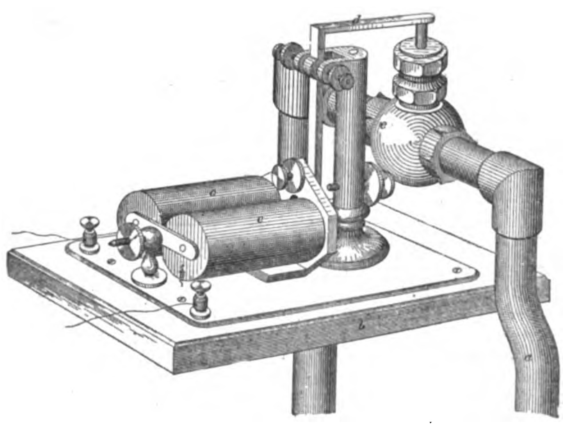


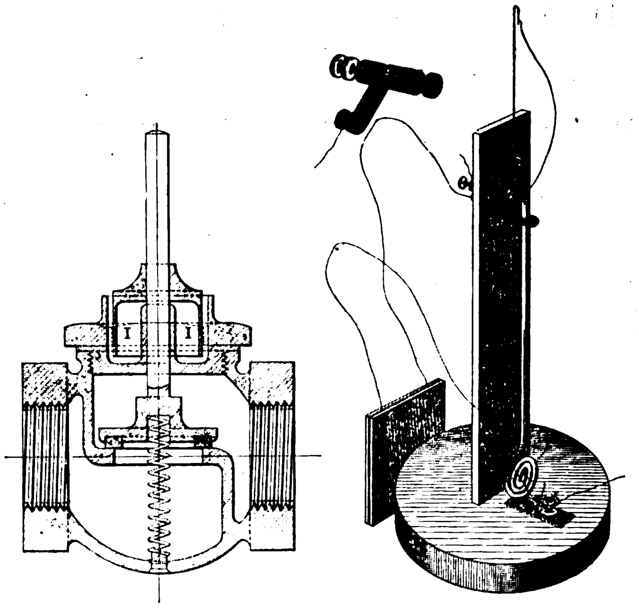
FIG. 6.—AUTOMATIC GAS VALVE AND CONTROLLING MAGNET.

The upper wire is set at the temperature to be kept constant and the burners are lighted. As soon, then, as this temperature is reached, contact is made between the mercury column and the upper wire, the circuit is closed, the electromagnetic valve is shut and the supply of gas interrupted. This conditions of things remains, of course, until the falling temperature of the room causes the contact in the thermostat to be broken, when the spring in the valve, no longer being resisted by the magnet, opens the way for a new supply of gas to the burners. This is lighted by the small jets referred to and the temperature of the water is again raised. This action goes on indefinitely and the arrangement adjusts itself so accurately that no appreciable deviation from the temperature required takes place. By this means the chronometers are tested within any desired range and are regulated accordingly.

Not only are the chronometers of American make throughout, as stated above, but it is worthy of note that all of the many electrical instruments used in the observatory are also made in this country by Messrs. J. H. Bunnell & Co., of New York.

The whole observatory is equipped in all respects as though it were permanent and gives the visitor an excellent idea of the real thing. The nice methods and delicate instruments form a striking contrast to much of the other electrical work about the grounds and cannot fail to fascinate the lovers of exact science. The great dynamos and engines in Machinery Hall are wonderful. The time system in the Naval Observatory is perfect.

To Lieut. A. G. Winterhalter, U. S. N., the officer in charge of the exhibit, I am indebted for the data from which this article was compiled, as well as for the illustrations accompanying it.

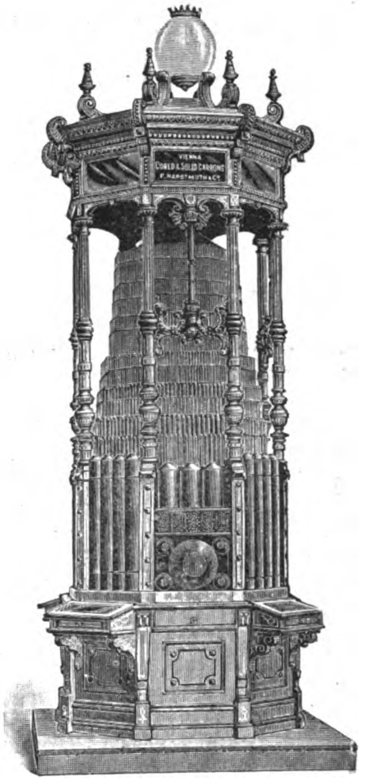


Figs. 5 and 7.—Automatic Gas Valve and Thermostat.

THE GENERAL ELECTRIC WORLD'S FAIR FOLDER.

A most artistic and comprehensive "folder" is now being distributed by the General Electric Co., as an epitome of its World's Fair exhibit, and to give the public visiting the Fair an idea of the vast range of the Company's work. This folder when closed is 3½ inches wide and 7½ inches long, and opens out into 28 pages, all of which are beautifully illustrated. The idea originated with Mr. Luther Stieringer, was worked up and carried through by Mr. John McGhie, the company's advertising manager, and was printed by Bartlett & Co., who not only did the press work but furnished the splendid series of designs and wash drawings in half-tone that adorn every page. A vast amount of information has been crowded, without apparent effort or squeezing, into this folder, and every cut has a special and ingenious application to the story it is intended to tell, in the departments of light, heat, power, traction, decorative work, etc. There is also a careful little synopsis of the company's triumphs at various exhibitions and in the courts. One cannot imagine a better thing than this to circulate at the Fair, and, for that matter, the country over; while the beauty of the illustrations suggests that it would certainly be worth while to print a few in brochure form, for preservation and reference after the Fair has gone, as a souvenir of the occasion and of the company's superb exhibit.

HARDTMUTH CARBONS AT THE WORLD'S FAIR.



Hardtmuth Carbons at the World's Fair.

The Hardtmuth carbon exhibit in the Electrical Building is attracting wide-spread attention. Messrs. Hardtmuth & Co. of Vienna, evidently appreciate the increasing demand for high grade carbons in the United States, and have, in connection with their American representatives, the International Thomson-Houston Co., made a very elaborate and creditable exhibit. Both solid and cored carbons are shown, varying in diameter from $\frac{1}{8}$ of an inch to 12 inches. European experience has demonstrated beyond a doubt, it is said, that arc lamps run in multiple arc are in every way preferable to the series system. The almost insurmountable obstacle in promoting multiple arc lighting in this country has been the fact that American carbon manufacturers have thus far, it is asserted, failed to produce a carbon sufficiently soft and fine for use in low potential arc lamps. Notwithstanding the very greatly increased cost of these carbons over American carbons, Messrs. Hardtmuth & Co. have already succeeded in securing a large amount of business. We are informed that Messrs. Hardtmuth & Co. have the largest carbon manufacturing plant in the world, and that they control over two-thirds of the entire business in Europe.

Mr. Moriz von Hardtmuth is here in person looking after the interests of his company. He informs me that his company has lately made a very valuable discovery in the manufacture of carbons, whereby the efficiency of Hardtmuth carbons has increased over 30 per cent., and at the same time giving an increased light of 25 per cent. over the old style carbons. With this advantage and a reduced price they hope to secure a much larger share of the American business.

The World's Columbian Exposition has purchased 100,000 of these carbons for exclusive use in arc lamps running on incandescent and motor circuits, tests having shown their superiority.

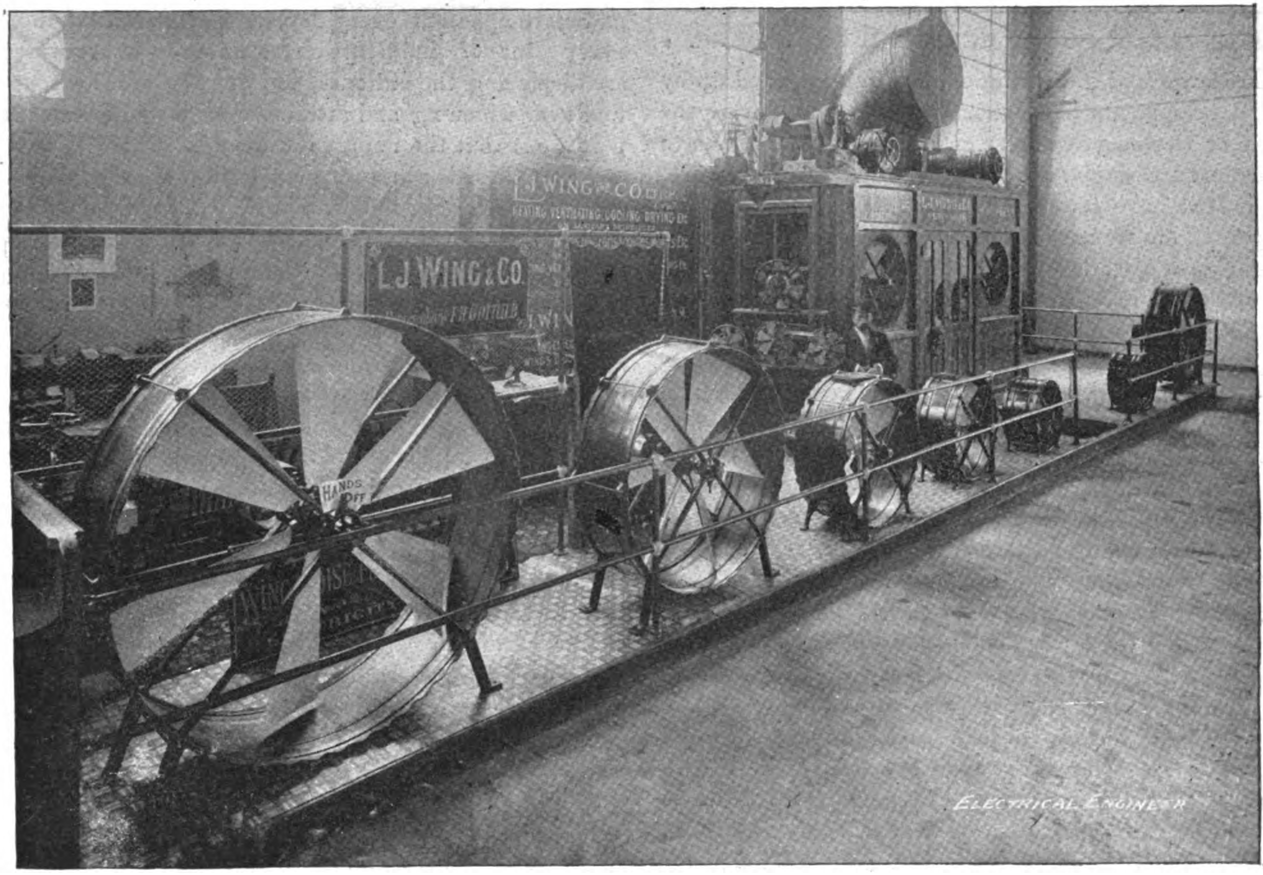
RELIANCE GAUGES AT THE FAIR.

The Reliance Gauge Company of Cleveland, Ohio, have one of the most attractive exhibits on the second floor of the Electricity Building, showing a full assortment of their celebrated "Reliance" safety alarm water columns for steam boilers varying in size from 1 to 1,000 h. p. The exhibit is very handsomely and tastefully arranged. The floor is covered with Brussels carpet and the stands with plush, while olive plush draperies form a background against which the highly polished aluminum, brass and nickel-plated columns stand out in bold relief, giving the exhibit a very artistic appearance.

The electrical exhibits at the Fair appear to be among the most popular with the public, and the Building now has a great many visitors.

WHERE BREEZES BLOW.

No spot within the four walls of the Electricity Building will be more popular when the hot weather comes to stay than "P, 10," in the northeast corner of the ground floor where L. J. Wing & Co., of 126 Liberty street, New York, show ventilating fans of all varieties and in all sorts of combinations. The accompanying illustration gives a good general idea of the exhibit. In the centre of the platform is the pavilion containing fans for experimental purposes arranged to show their power either for pressure or exhaust. A Perret motor of four h. p., built by the Elektron Manufacturing Company, of Springfield, Mass., stands in one corner of the pavilion and is belted to a countershaft on the roof truss. From this is driven a 48-inch exhaust fan placed horizontally in the ceiling, and one of 36 inches in the front wall at the left of the entrance. One 12-inch and two 18-inch fans standing on the edge of the roof are also driven from the same shaft. One of the latter is connected by means of sheet iron pipes with a forge, a steam vat and two closets showing the variety of uses to which a single fan is applicable.



Fan, Blower and Ventilator Exhibit of L. J. Wing & Co.

On the right of the pavilion door is another 36-inch Wing disc fan directly connected with a Diehl motor, so that the motor being on the shaft at the centre of the fan, the current of air is quite unobstructed. The pavilion is divided into three communicating compartments and the three large fans in the roof and walls are made to show their power by opening or shutting the doors between by the simple process of throwing a switch. The switchboard is at the rear of the right hand compartment and from it all the fans in the exhibit are controlled on circuits of 110, 220 and 500 volts.

Outside in the "space" are other styles of fans for various uses. A Diehl ceiling combination with very long blades keeps the air gently in motion from above, while on a table at one side is an 18-inch Wing disc fan with a Diehl motor, a 12-inch Crocker-Wheeler revolving fan, distributing its breeze equally to all points of the compass; another of the same make, but stationary, for desks and tables, and a Meston alternating current motor and fan. Along the front of the platform, forming a barrier about the display, is a row of fans ranging from five to two feet in diameter and decreasing by steps of six inches. These are shown driven by motors direct-connected and belted and also by high speed steam engines, also direct-connected in the manner already described in these columns.

In the left hand corner of the platform is the office of Mr. F. H. Gottlieb, the company's representative at the Fair. Mr. Gottlieb is one of the busiest men in the Exposition at present and combines the offices of host, showman, and business representative in a manner that cannot fail to add both friends and gold to the company's account. He has already put numbers of the fans in restaurants, cafés, etc., throughout the grounds, besides furnishing others to individual exhibitors. The display is very well arranged and is so happily selected that all the latest and most improved forms of fans and combinations are shown within a small space without crowding.

SUNDAY OPENING AT THE WORLD'S FAIR.

The opening of the World's Fair on the two Sundays, May 28, and June 4 was a great success, the grounds being visited by many thousand quiet and well-conducted persons. Steps have been taken, however, to close the gates "legally," and as a result a decision has been obtained in the Federal Court at Chicago which enjoins the World's Fair authorities from respecting the Constitution so far as it relates to the unalienable right to the pursuit of happiness, and which will, therefore, prevent the pursuit of happiness being carried on in Jackson Park. It is not understood, however, that the persons debarred from the Park intend practising psalmody instead. The Fair was open again on Sunday, June 11.

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World's Fair Editor: George B. Muldaur.
New England Editor and Manager, A. C. Shaw, Room 70—620 Atlantic Avenue Boston, Mass.
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THE OUTLOOK FOR ELECTRICAL ENGINEERS.

THE large and increasing opportunities opened up by developments in electrical applications during the last ten or twelve years have caused many young men to turn to electrical engineering as their chosen field of work. Many indeed have found therein profitable and congenial employment, but we have of late encountered an unmistakeable sentiment that even now the profession of electrical engineering is beginning to suffer from an evil which we had believed to be confined to some of the older professions, namely, overcrowding. More recently, well defined complaints of this nature reach us from France, where, it is alleged, technically-trained electrical engineers fail to find suitable employment. From the number of German and English electrical engineers who are constantly seeking these shores it is fair to assume that a like condition of affairs exists in their native countries. As the influx of foreigners trained in other branches of engineering has been going on for many years, the proportion of electrical engineers among them may be looked upon as the normal amount of European "overproduction" of trained men, which has long since become one of the most serious problems Europe has to contend with. In view of these facts, however, it seems worth while to consider whether we have arrived at a point where it is desirable to limit the number of those who take up electrical engineering as a profession in this country also. Touching on this point, in an able article on "The Electrical Engineer and His Work," in the Year Book of the Society of Engineers, Prof. Geo. D. Shepardson, of the University of Minnesota, calls attention to the fact that the increase in the number of students in our colleges taking up the course of electrical engineering is increasing at an enormous rate, the growth in this direction being illustrated by the fact that whereas in 1884 there were 28 students in the electrical course at Cornell, the number in 1892 had risen to 275! In the University of Minnesota half the Freshmen in the College of Metallurgy, Engineering and Mechanical Arts, are registered for the electrical engineering course. Prof. Shepardson holds the view that "the supply of *beginners* is greater than the demand," and that there must be a reaction from this tendency, for the reason, that there are equally great opportunities in other lines of engineering. He points out, with much truth, that many of those who rush into electricity are utterly unfitted to become engineers, having neither ability, perseverance nor genius, and that they are tempted to take up the profession by the supposed chances of acquiring large fortunes in a comparatively short time. While we are fully prepared to agree with Prof. Shephardson in some of these points, we are not by any means prepared to assert that the supply of good and competent electrical engineers in this country is equal to the demand; or, to put it in another way, that those who make electricity their specialty at college are likely to find little opportunity for agreeable and lucrative occupation in life.

Indeed, Prof. Shepardson's article itself offers excellent evidence that those who take up the study of electricity and its applications in this country will find a field of operation of almost limitless extent. It is becoming more and more apparent every day, as he states, that in nearly every line of industry electrical processes or methods are displacing the old ones, and the inventor and engineer find ever-widening and attractive fields of labor. He also points out that the supply business is attractive to many, and that there is room for an electrical supply house and a contracting firm in almost every city. Surely success in either of these fields of activity is more assured to one trained in electrical work than to one not so equipped. Nor does he lose sight of the fact that the rapid growth and differentiation of electrical industries is accompanied by a corresponding development in the technical press, that nearly all engineering papers now profess to have an electrical department, and that at no very distant day the great daily and weekly newspapers will employ electrical or engineering editors, or at least reporters who are intelligently informed on electrical subjects. Then again, there is a steady demand for good teachers in electrical engineering, and Prof. Shepardson cites as a matter of fact, that there were more than a dozen vacancies to be filled in our various schools and colleges last September, and that some of them are still unfilled.

In addition to all these avenues there is the growing number of lawyers, patent attorneys, etc., who are devoting special attention to electrical work, and whose ranks must be filled, or who must be assisted, by those trained in the art. When we add to these the telephone and telegraph companies which are beginning to feel most acutely the need of trained electricians, it is difficult to see how the supply can exceed the demand for a long time to come. Indeed, curiously enough, after bringing forward all these points, Prof. Shepardson himself acknowledges that the demand for educated electricians is continuously increasing. While we may, therefore, limit his assertions, as to the present over-supply, to "beginners," it is difficult to see how the ranks of the educated electrician can be filled without them. It is not to be supposed that the proportion of those entering the electrical professions who make a success of it is greater than those entering upon other professions, or that disappointments must not be looked for in a large number of cases; but we believe we are safe in asserting that with proper equipment for the profession the competent electrical engineer in this country to-day has larger opportunities than are offered any other professional men—except, perhaps, the lawyers who conduct the great electro-legal fights.

MISCELLANEOUS.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.[1]—III.

BY NIKOLA TESLA.

ON ELECTRICAL RESONANCE.

The effects of resonance are being more and more noted by engineers and are becoming of great importance in the practical operation of apparatus of all kinds with alternating currents. A few general remarks may therefore be made concerning these effects. It is clear, that if we succeed in employing the effects of resonance practically in the operation of electric devices the return wire will, as a matter of course, become unnecessary, for the electric vibration may be conveyed with one wire just as well, and sometimes even better, than with two. The question first to answer is, then, whether pure resonance effects are producible. Theory and experiment both show that such is impossible in Nature, for as the oscillation becomes more and more vigorous the losses in the vibrating bodies and environing media rapidly increase and necessarily check the vibration which otherwise would go on increasing forever. It is a fortunate circumstance that pure resonance is not producible, for if it were there is no telling what dangers might not lie in wait for the innocent experimenter. But to a certain degree resonance is producible, the magnitude of the effects being limited by the imperfect conductivity and imperfect elasticity of the media or, generally stated, by frictional losses. The smaller these losses, the more striking are the effects. The same is the case in mechanical vibration. A stout steel bar may be set in vibration by drops of water falling upon it at proper intervals; and with glass, which is more perfectly elastic, the resonance effect is still more remarkable, for a goblet may be burst by singing into it a note of the proper pitch. The electrical resonance is the more perfectly attained, the smaller the resistance or the impedance of the conducting path and the more perfect the dielectric. In a Leyden jar discharging through a short stranded cable of thin wires these requirements are probably best fulfilled, and the resonance effects are therefore very prominent. Such is not the case with dynamo machines, transformers and their circuits, or with commercial apparatus in general in which the presence of iron cores complicates or renders impossible the action. In regard to Leyden jars with which resonance effects are frequently demonstrated, I would say that the effects observed are often *attributed* but are seldom *due* to true resonance, for an error is quite easily made in this respect. This may be undoubtedly demonstrated by the following experiment. Take, for instance, two large insulated metallic plates or spheres which I shall designate A and B, place them at a certain small distance apart and charge them from a frictional or influence machine to a potential so high that just a slight increase of the difference of potential between them will cause the small air or insulating space to break down. This is easily reached by making a few preliminary trials. If now another plate—fastened on an insulating handle and connected by a wire to one of the terminals of a high tension secondary of an induction coil, which is maintained in action by an alternator (preferably high frequency) —is approached to one of the charged bodies A or B, so as to be nearer to either one of them, the discharge will invariably occur between them; at least it will, if the potential of the coil in connection with the plate is sufficiently high. But the explanation of this will soon be found in the fact that the approached plate acts inductively upon the bodies A and B and causes a spark to pass between them. When this spark occurs, the charges, which were previously imparted to these bodies from the influence machine, must needs be lost, since the bodies are brought in electrical connection through the arc formed. Now this arc is formed whether there be resonance or not. But even if the spark would not be produced, still there is an alternating E. M. F. set up between the bodies when the plate is brought near one of them; therefore the approach of the plate, if it *does* not always, actually, will, at any rate, *tend*, to break down the air space by inductive action. Instead of the spheres or plates A and B we may take the coatings of a Leyden jar with the same result, and in place of the machine, which is a high frequency alternator preferably, because it is more suitable for the experiment and also for the argument, we may take another Leyden jar or battery of jars. When such jars are discharging through a circuit of low resistance the same is traversed by currents of very high frequency. The plate may now be connected to one of the coatings of the second jar, and when it is brought near to the first jar just previously charged to a high potential from an influence machine, the result is the same as before, and the first jar will discharge through a small air space upon the second being caused to discharge. But both jars and their circuits need not be tuned any closer than a basso profundo is to the note produced by a mosquito, as small sparks will be produced through the air space, or at least the latter will be considerably more strained owing to the setting up of an alternating E. M. F. by induction, which takes place when one of the jars begins to discharge. Again another error of a similar nature is quite easily made. If the circuits of the two jars are run parallel and close together, and the experiment has been performed of discharging one by the other, and now a coil of wire be added to one of the circuits whereupon the experiment does not succeed, the conclusion that this is due to the fact that the circuits are now not tuned, would be far from being safe. For the two circuits act as condenser coatings and the addition of the coil to one of them is equivalent to bridging them, at the point where the coil is placed, by a small condenser, and the effect of the latter might be to prevent the spark from jumping through the discharge space by diminishing the alternating E. M. F. acting across the same. All these remarks, and many more which might be added but for fear of wandering too far from the subject, are made with the pardonable intention of cautioning the unsuspecting student, who might gain an entirely unwarranted opinion of his skill when seeing every experiment succeed; but they are in no way thrust upon the experienced as novel observations.

In order to make reliable observations of electric resonance effects it is very desirable, if not necessary, to employ an alternator giving currents which rise and fall harmonically, as in working with make and break currents the observations are not always trustworthy, since many phenomena, which depend on the rate of change, may be produced with frequencies widely different. Even when making such observations with an alternator one is apt to be mistaken. When a circuit is connected to an alternator there are an infinite number of values for capacity and self-induction which, in conjunction, will satisfy the condition of resonance. So there are in mechanics an infinite number of tuning forks which will respond to a note of a certain pitch, or loaded springs which have a definite period of vibration. But the resonance will be most perfectly attained in that case in which the motion is effected with the greatest freedom. Now in mechanics, considering the vibration in the common medium—that is, air—it is of comparatively little importance whether one tuning fork be somewhat larger than another, because the losses in the air are not very considerable. One may of course enclose a tuning fork in an exhausted vessel and by thus reducing the air resistance to a minimum obtain better resonant action. Still the difference would not be very great. But it would make a great difference if the tuning fork were immersed in mercury. In the electrical vibration it is of enormous importance to arrange the conditions so that the vibration is effected with the greatest freedom. The magnitude of the resonance effect depends, under otherwise equal conditions, on the quantity of electricity set in motion or on the strength of the current driven through the circuit. But the circuit opposes the passage of the currents by reason of its impedance and therefore, to secure the best action it is necessary to reduce the impedance to a minimum. It is impossible to overcome it entirely, but merely in part, for ohmic resistance cannot be overcome. But when the frequency of the impulses is very great, the flow of the current is practically determined by self-induction. Now self-induction can be overcome by combining it with capacity. If the relation between these is such, that at the frequency used they annul each other, that is, have such values as to satisfy the condition of resonance and the greatest quantity of electricity is made to flow through the external circuit, then the best result is obtained. It is simpler and safer to join the condenser in series with the self-induction. It is clear that in such combinations there will be, for a given frequency, and considering only the fundamental vibration, values which will give the best result, with the condenser in shunt to the self-induction coil; of course more such values than with the condenser in series. But practical conditions determine the selection. In the latter case in performing the experiments one may take a small self-induction and a large capacity or a small capacity and a large self-induction, but the latter is preferable, because it is inconvenient to adjust a large capacity by small steps. By taking a coil with a very large self-induction the critical capacity is reduced to a very small value, and the capacity of the coil itself may be sufficient. It is easy, especially by observing certain artifices, to wind a coil through which the impedance will be reduced to the value of the ohmic resistance only and for any coil there is, of course, a frequency at which the maximum current will be made to pass through the coil. The observation of the relation between self-induction, capacity and frequency is becoming important in the operation of alternate current apparatus, such as transformers or motors, because by a judicious determination of the elements the employment of an expensive condenser becomes unnecessary. Thus it is possible to pass through the coils of an alternating current motor under the normal working conditions the required current with a low E. M. F. and do away entirely with the false current, and the larger the motor the easier such a plan becomes practicable; but it is necessary for this to employ currents of very high potential or high frequency.

In Fig. 20 I is shown (see THE ELECTRICAL ENGINEER, June 7, 1893) a plan which has been followed in the study of the resonance effects by means of a high frequency alternator. C is a coil of many turns, which is divided in small separate sections for the purposes of adjustment. The final adjustment was made sometimes with a few thin iron wires (though this is not always advisable) or with a closed secondary. The coil C is connected with one of its ends to the line L from the alternator G and with the other end to one of the plates c of a condenser $c c_1$, the plate (c_1) of the latter being connected to a much larger plate P_1. In this manner both capacity and self-induction were adjusted to suit the dynamo frequency.

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[1] A lecture delivered before the Franklin Institute, at Philadelphia, Feb. 24, 1893, and before the National Electric Light Association, at St. Louis, Mo., March 1, 1893.

As regards the rise of potential through resonant action, of course, theoretically, it may amount to anything since it depends on self-induction and resistance and since these may have any value. But in practice one is limited in the selection of these values and besides these, there are other limiting causes. One may start with, say, 1,000 volts and raise the E. M. F. to 50 times that value, but one cannot start with 100,000 and raise it to ten times that value because of the losses in the media which are great, especially if the frequency is high. It should be possible to start with, for instance, two volts from a high or low frequency circuit of a dynamo and raise the E. M. F. to many hundred times that value. Thus coils of the proper dimensions might be connected each with only one of its ends to the mains from a machine of low E. M. F., and though the circuit of the machine would not be closed in the ordinary acceptance of the term, yet the machine might be burned out if a proper resonance effect would be obtained. I have not been able to produce, nor have I observed with currents from the dynamo machine, such great rises of potential. It is possible, if not probable, that with currents obtained from apparatus containing iron the disturbing influence of the latter is the cause that these theoretical possibilities cannot be realized. But if such is the case I attribute it solely to the hysteresis and Faucault current losses in the core. Generally it was necessary to transform upward, when the E. M. F. was very low, and usually an ordinary form of induction coil was employed, but sometimes the arrangement illustrated in Fig. 20 II, has been found to be convenient. In this case a coil C is made in a great many sections, a few of these being used as the primary. In this manner both primary and secondary are adjustable. One end of the coil is connected to the line L_1 from the alternator, and the other line L is connected to the intermediate point of the coil. Such a coil with adjustable primary and secondary will be found also convenient in experiments with the disruptive discharge. When true resonance is obtained the top of the wave must of course be on the free end of the coil as, for instance, at the terminal of the phosphorescence bulb B. This is easily recognized by observing the potential of a point on the wire *w* nearer to the coil.

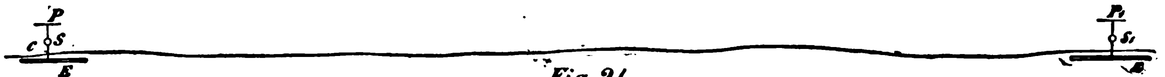


Fig. 21

FIG. 21.—ENERGY TRANSMISSION TO ANY DISTANCE WITHOUT WIRES.

In connection with resonance effects and the problem of transmission of energy over a single conductor which was previously considered, I would say a few words on a subject which constantly fills my thoughts and which concerns the welfare of all. I mean the transmission of intelligible signals or perhaps even power to any distance without the use of wires. I am becoming daily more convinced of the practicability of the scheme; and though I know full well that the great majority of scientific men will not believe that such results can be practically and immediately realized, yet I think that all consider the developments in recent years by a number of workers to have been such as to encourage thought and experiment in this direction. My conviction has grown so strong that I no longer look upon this plan of energy or intelligence transmission as a mere theoretical possibility, but as a serious problem in electrical engineering, which must be carried out some day. The idea of transmitting intelligence without wires is the natural outcome of the most recent results of electrical investigations. Some enthusiasts have expressed their belief that telephony to any distance by induction through the air is possible. I cannot stretch my imagination so far, but I do firmly believe that it is practicable to disturb by means of powerful machines the electrostatic condition of the earth and thus transmit intelligible signals and perhaps power. In fact, what is there against the carrying out of such a scheme? We now know that electric vibration may be transmitted through a single conductor. Why then not try to avail ourselves of the earth for this purpose? We need not be frightened by the idea of distance. To the weary wanderer counting the mile-posts the earth may appear very large, but to that happiest of all men, the astronomer, who gazes at the heavens and by their standard judges the magnitude of our globe, it appears very small. And so I think it must seem to the electrician, for when he considers the speed with which an electric disturbance is propagated through the earth all his ideas of distance must completely vanish.

A point of great importance would be first to know what is the capacity of the earth? and what charge does it contain if electrified? Though we have no positive evidence of a charged body existing in space without other oppositely electrified bodies being near, there is a fair probability that the earth is such a body, for by whatever process it was separated from other bodies—and this is the accepted view of its origin—it must have retained a charge, as occurs in all processes of mechanical separation. If it be a charged body insulated in space its capacity should be extremely small, less than one-thousandth of a farad. But the upper strata of the air are conducting, and so, perhaps, is the medium in free space beyond the atmosphere, and these may contain an opposite charge. Then the capacity might be incomparably greater. In any case it is of the greatest importance to get an idea of what quantity of electricity the earth contains. It is difficult to say whether we shall ever acquire this necessary knowledge, but there is hope that we may, and that is, by means of electrical resonance. If ever we can ascertain at what period the earth's charge, when disturbed, oscillates with respect to an oppositely electrified system or known circuit, we shall know a fact possibly of the greatest importance to the welfare of the human race. I propose to seek for the period by means of an electrical oscillator, or a source of alternating electric currents. One of the terminals of the source would be connected to earth as, for instance, to the city water mains, the other to an insulated body of large surface. It is possible that the outer conducting air strata or free space contains an opposite charge and that, together with the earth, they form a condenser of very large capacity. In such case the period of vibration may be very low and an alternating dynamo machine might serve for the purpose of the experiment. I would then transform the current to a potential as high as it would be found possible and connect the ends of the high tension secondary to the ground and to the insulated body. By varying the frequency of the currents and carefully observing the potential of the insulated body and watching for the disturbance at various neighboring points of the earth's surface resonance might be detected. Should, as the majority of scientific men in all probability believe, the period be extremely small, then a dynamo machine would not do and a proper electrical oscillator would have to be produced and perhaps it might not be possible to obtain such rapid vibrations. But whether this be possible or not, and whether the earth contains a charge or not, and whatever may be its period of vibration, it certainly is possible—for of this we have daily evidence—to produce some electrical disturbance sufficiently powerful to be perceptible by suitable instruments at any point of the earth's surface.

Assume that a source of alternating currents S be connected, as in Fig. 21, with one of its terminals to earth (conveniently to the water mains) and with the other to a body of large surface P. When the electric oscillation is set up there will be a movement of electricity in and out of P, and alternating currents will pass through the earth, converging to, or diverging from, the point C where the ground connection is made. In this manner neighboring points on the earth's surface within a certain radius will be disturbed. But the disturbance will diminish with the distance, and the distance at which the effect will still be perceptible will depend on the quantity of electricity set in motion. Since the body P is insulated, in order to displace a considerable quantity the potential of the source must be excessive, since there would be limitations as to the surface of P. The conditions might be adjusted so that the generator or source S will set up the same electrical movement as though its circuit were closed. Thus it is certainly practicable to impress an electric vibration at least of a certain low period upon the earth, by means of proper machinery. At what distance such a vibration might be made perceptible can only be conjectured. I have on another occasion considered the question how the earth might behave to electric disturbances. There is no doubt that, since in such an experiment the electrical density at the surface could be but extremely small considering the size of the earth, the air would not act as a very disturbing factor and there would be not much energy lost through the action of the air which would be the case if the density were great. Theoretically, then, it could not require a great amount of energy to produce a disturbance perceptible at great distance, or even all over the surface of the globe. Now it is quite certain that at any point within a certain radius of the source S a properly adjusted self-induction and capacity device can be set in action by resonance. But not only can this be done, but another source S_1 Fig. 21, similar to S, or any number of such sources can be set to work in synchronism with the latter and the vibration thus intensified and spread over a large area, or a flow of electricity produced to or from the source S_1 if the same be of opposite phase to the source S. I think that beyond doubt it is possible to operate electrical devices in a city through the ground or pipe system by resonance from an electrical oscillator located at a central point. But the practical solution of this problem would be of incomparably smaller benefit to man than the realization of the scheme of transmitting intelligence or perhaps power to any distance through the earth or environing medium. If this is at all possible, distance does not mean anything. Proper apparatus must first be produced by means of which the problem can be attacked and I have devoted much thought to this subject. I am firmly convinced that it can be done and hope that we shall live to see it done.

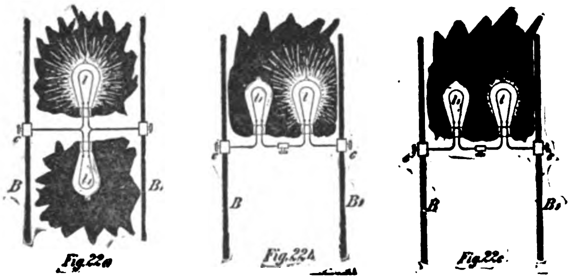
ON THE LIGHT PHENOMENA PRODUCED BY HIGH-FREQUENCY CURRENTS OF HIGH POTENTIAL AND GENERAL REMARKS RELATING TO THE SUBJECT.

Returning now to the light effects which it has been the chief object to investigate, it is thought proper to divide these effects into four classes: 1. Incandescence of a solid. 2. Phosphorescence. 3. Incandescence or phosphorescence of a rarefied gas, and 4. Luminosity produced in a gas at ordinary pressure. The first question is, How are these luminious effects produced? In order to answer this question as satisfactorily as I am able to do in the light of accepted views and with the experience acquired, and to add some interest to this demonstration, I shall dwell here upon a feature which I consider of great importance, inasmuch as it promises, besides, to throw a better light upon the nature of most of the phenomena produced by high-frequency electric currents. I have on other occasions pointed out the great importance of the presence of the rarefied gas, or atomic medium in general, around the conductor through which alternate currents of high frequency are passed, as regards the heating of the conductor by the currents. My experiments described some time ago have shown that the higher the frequency and potential difference of the currents, the more important becomes the rarefied gas in which the conductor is immersed, as a factor of the heating. The potential difference, however, is, as I then pointed out, a more important element than the frequency. When both of these are sufficiently high, the heating may be almost entirely due to the presence of the rarefied gas. The experiments to follow will show the importance of the rarefied gas, or generally of gas at ordinary or other pressure as regards the incandescence or other luminous effects produced by currents of this kind.

I take two ordinary 50-volt 16 c. p. lamps which are in every respect alike, with the exception, that one has been opened at the top and the air has filled the bulb, while the other is at the ordinary degree of exhaustion of commercial lamps. When I attach the lamp which is exhausted to the terminal of the secondary of the coil, which I have already used as in experiments illustrated in Fig. 15*a* for instance, and turn on the current, the filament as you have before seen comes to high incandescence. When I attach the second lamp, which is filled with air, instead of the former, the filament still glows, but much less brightly. This experiment illustrates only in part the truth of the statements before made. The importance of the filament's being immersed in rarefied gas is plainly noticeable but not to such a degree as might be desirable. The reason is that the secondary of this coil is wound for low tension, having only 150 turns, and the potential difference at the terminals of the lamp is therefore small. Were I to take another coil with many more turns in the secondary, the effect would be increased, since it depends partially on the potential difference, as before remarked. But since the effect likewise depends on the frequency, it may be properly stated that it depends on the time rate of the variation of the potential difference. The greater this variation the more important becomes the gas as an element of heating. I can produce a much greater rate of variation in another way, which, besides has the advantage of doing away with the objections, which might be made in the experiment just shown, even if both the lamps were connected in series or multiple arc to the coil, namely, that in consequence of the reactions existing between the primary and secondary coil the conclusions are rendered uncertain. This result I secure by charging from an ordinary transformer, which is fed from the alternating current supply station, a battery of condensers, and discharging the latter directly through a circuit of small self-induction, as before illustrated in Fig. 19*a*, 19*b*, 19*c*.

In Figs. 22*a*, 22*b* and 22*c*, the heavy copper bars BB$_1$, are connected to the opposite coatings of a battery of condensers, or generally in such way, that the high frequency or sudden discharges are made to traverse them. I connect first an ordinary 50-volt incandescent lamp to the bars by means of the clamps *cc*. The discharges being passed through the lamp, the filament is rendered incandescent, though the current through it is very small, and would not be nearly sufficient to produce a visible effect under the conditions of ordinary use of the lamp. Instead of this I now attach to the bars another lamp exactly like the first, but with the seal broken off, the bulb being therefore filled with air at ordinary pressure. When the discharges are directed through the filament, as before, it does not become incandescent. But the result might still be attributed to one of the many possible reactions. I therefore connect both the lamps in multiple arc as illustrated in Fig. 22*a*. Passing the discharges through both the lamps, again the filament in the exhausted lamp *l* glows very brightly while that in the non-exhausted lamp l_1 remains dark, as previously. But it should not be thought that the latter lamp is taking only a small fraction of the energy supplied to both the lamps; on the contrary, it may consume a considerable portion of the energy and it may become even hotter than the one which burns brightly. In this experiment the potential difference at the terminals of the lamps varies in sign theoretically three to four million times a second. The ends of the filaments are correspondingly electrified, and the gas in the bulbs is violently agitated and a large portion of the supplied energy is thus converted into heat. In the non-exhausted bulb there being a few million times more gas molecules than in the exhausted one, the bombardment, which is most violent at the ends of the filament, in the neck of the bulb, consumes a large portion of the energy without producing any visible effect. The reason is that, there being many molecules, the bombardment is quantitatively considerable, but the individual impacts are not very violent, as the speeds of the molecules are comparatively small owing to the small free path. In the exhausted bulb on the contrary the speeds are very great and the individual impacts are violent and therefore better adapted to produce a visible effect. Besides, the convection of heat is greater in the former bulb. In both the bulbs the current traversing the filaments is very small, incomparably smaller than that which they require on an ordinary low-frequency circuit. The potential difference, however, at the ends of the filaments is very great and might be possibly 20,000 volts or more, if the filaments were straight and their ends far apart. In the ordinary lamp a spark generally occurs between the ends of the filament or between the platinum wires outside, before such a difference of potential can be reached.

It might be objected in the experiment before shown that the lamps, being in multiple arc, the exhausted lamp might take a much larger current and that the effect observed might not be exactly attributable to the action of the gas in the bulbs. Such objections will lose much weight if I connect the lamps in series, with the same result. When this is done and the discharges are directed through the filaments it is again noted, that the filament in the non-exhausted bulb l_1 remains dark while that in the exhausted one (*l*) glows even more intensely than under its normal conditions of working, Fig. 22*b*. According to general ideas the current through the filaments should now be the same, were it not modified by the presence of the gas around the filaments.



FIGS. 22*a*, 22*b* AND 22*c*.—SHOWING THE EFFECT OF THE PRESENCE OF A GASEOUS MEDIUM.

At this juncture I may point out another interesting feature, which illustrates the effect of the rate of change of potential of the currents. I will leave the two lamps connected in series to the bars BB$_1$ as in the previous experiment, Fig. 22*b*, but will presently reduce considerably the frequency of the currents, which was excessive in the experiment just before shown. This I may do by inserting a self-induction coil in the path of the discharges, or by augmenting the capacity of the condensers. When I now pass these low-frequency discharges through the lamps, the exhausted lamp *l* again is as bright as before but it is noted also that the non-exhausted lamp l_1 glows, though not quite as intensely as the other. Reducing the current through the lamps, I may bring the filament in the latter lamp to redness, and, though the filament in the exhausted lamp *l* is bright, Fig. 22*c*, the degree of its incandescence is much smaller than in Fig. 22*b*, when the currents were of a much higher frequency.

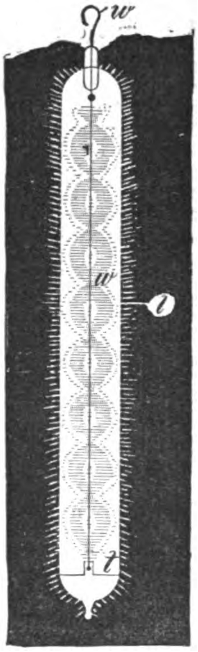
In these experiments the gas acts in two opposite ways in determining the degree of the incandescence of the filaments, that is, by convection and bombardment. The higher the frequency and potential of the currents, the more important becomes the bombardment. The convection on the contrary should be the smaller, the higher the frequency. When the currents are steady, there is practically no bombardment and convection may therefore with such currents also considerably modify the degree of incandescence and produce results similar to those just before shown. Thus, if two lamps exactly alike, one exhausted and one not exhausted, are connected in multiple arc or series to a direct-current machine, the filament in the non-exhausted lamp will require a considerably greater current to be rendered incandescent. This result is entirely due to convection and the effect is the more prominent the thinner the filament. Professor Ayrton and Mr. Kilgour some time ago published quantitative results concerning the thermal emissivity by radiation and convection in which the effect of thin wires was clearly shown. This effect may be strikingly illustrated by preparing a number of small short glass tubes, each containing through its axis the thinnest obtainable platinum wire. If these tubes be highly exhausted, a number of them may be connected in multiple arc to a direct-current machine and all of the wires may be kept at incandescence with a smaller current than that required to render incandescent a single one of the wires if the tube be not exhausted. Could the tubes be so highly exhausted that convection would be nil, then the relative amounts of heat given off by convection and radiation could be determined without the difficulties attending thermal quantitative measurements. If a source of electric impulses of high frequency and very high potential is employed, a still greater number of the tubes may be taken and the wires rendered incandescent by a current not capable of warming perceptibly a wire of the same size immersed in air at ordinary pressure, and conveying the energy to all of them.

I may here describe a result which is still more interesting, and to which I have been led by the observation of these phenomena. I noted that small differences in the density of the air produced a considerable difference in the degree of incandescence of the wires, and I thought that, since in a tube, through which a luminous discharge is passed, the gas is generally not of uniform density, a very thin wire contained in the tube might be rendered incandescent at certain places of smaller density of the gas, while it would remain dark at the places of greater density, where the convection would be greater and the bombardment less intense. Accordingly a tube *t* was prepared, as illustrated in Fig. 23, which contained through the middle a very fine platinum wire *w*. The tube was exhausted to a moderate degree and it was found that when it was attached to the terminal of a high-frequency coil the platinum wire *w* would, indeed, become incandescent in patches, as illustrated in Fig. 23. Later a number of these tubes with one or more wires were prepared, each showing this result. The effect was best noted when the striated discharge occurred in the tube, but was also produced when the striæ were not visible, showing that, even then, the gas in the tube was not of uniform density. The position of the striæ was generally such, that the rarefactions corresponded to the places of incandescence or greater brightness on the wire *w*. But in a few instances it was noted, that the bright spots on the wire were covered by the dense parts of the striated discharge as indicated by *l* in Fig. 23, though the effect was barely perceptible. This was explained in a plausible way by assuming, that the convection was not widely different in the dense and rarefied places, and that the bombardment was greater on the dense places of the striated discharge. It is, in fact, often observed in bulbs, that under certain conditions a thin wire is brought to higher incandescence when the air is not too highly rarefied. This is the case when the potential of the coil is not high enough for the vacuum, but the result may be attributed to many different causes. In all cases this curious phenomenon of incandescence disappears when the tube, or rather the wire, acquires throughout a uniform temperature.

Disregarding now the modifying effect of convection there are then two distinct causes which determine the incandescence of a wire or filament with varying currents, that is, conduction current and bombardment. With steady currents we have to deal only with the former of these two causes, and the heating effect is a minimum, since the resistance is least to steady flow. When the current is a varying one, the resistance is greater and hence the heating effect is increased. Thus if the rate of change of the current is very great, the resistance may increase to such an extent that the filament is brought to incandescence with inappreciable currents, and we are able to take a short and thick block of carbon or other material and bring it to bright incandescence with a current incomparably smaller than that required to bring to the same degree of incandescence an ordinary thin lamp filament with a steady or low frequency current. This result is important, and illustrates how rapidly our views on these subjects are changing, and how quickly our field of knowledge is extending. In the art of incandescent lighting, to view this result in one aspect only, it has been commonly considered as an essential requirement for practical success, that the lamp filament should be thin and of high resistance. But now we know that the resistance to the steady flow of the filament does not mean anything; the filament might as well be short and thick; for if it be immersed in rarefied gas it will become incandescent by the passage of a small current. It all depends on the frequency and potential of the currents. We may conclude from this, that it would be of advantage, so far as the lamp is considered, to employ high frequencies for lighting, as they allow the use of short and thick filaments and smaller currents.

If a wire or filament be immersed in a homogeneous medium, all the heating is due to true conduction current, but if it be enclosed in an exhausted vessel the conditions are entirely different. Here the gas begins to act and the heating effect of the conduction current, as is shown in many experiments, may be very small compared with that of the bombardment. This is especially the case if the circuit is not closed and the potentials are of course very high. Suppose a fine filament enclosed in an exhausted vessel be connected with one of its ends to the terminal of a high tension coil and with its other end to a large insulated plate. Though the circuit is not closed, the filament, as I have before shown, is brought to incandescence. If the frequency and potential be comparatively low, the filament is heated by the current passing *through* it. If the frequency and potential, and principally the latter, be increased, the insulated plate need be but very small, or may be done away with entirely; still the filament will become incandescent, practically all the heating being then due to the bombardment. A practical way of combining both the effects of conduction current and bombardment is illustrated in Fig. 24, in which an ordinary lamp is shown provided with a very thin filament which has one of the ends of the latter connected to a shade serving the purpose of the insulated plate, and the other end to the terminal of a high tension source. It should not be thought that only rarefied gas is an important factor in the heating of a conductor by varying currents, but gas at ordinary pressure may become important, if the potential difference and frequency of the currents is excessive. On this subject I have already stated, that when a conductor is fused by a stroke of lightning, the current through it may be exceedingly small, not even sufficient to heat the conductor perceptibly, were the latter immersed in a homogeneous medium.

From the preceding it is clear that when a conductor of high resistance is connected to the terminals of a source of high frequency currents of high potential, there may occur considerable dissipation of energy, principally on the ends of the conductor, in consequence of the action of the gas surrounding the conductor. Owing to this, the current through a section of the conductor at a point midway between its ends may be much smaller than through a section near the ends. Furthermore, the current passes principally through the outer portions of the conductor, but this effect is to be distinguished from the skin effect as ordinarily interpreted, for the latter would or should occur also in a continuous incompressible medium. If a great many incandescent lamps are connected in series to a source of such currents, the lamps at the ends may burn brightly, whereas those in the middle may remain entirely dark. This is due principally to bombardment, as before stated. But even if the currents be steady, provided the difference of potential is very great, the lamps at the ends will burn more brightly than those in the middle. In such case there is no rhythmical bombardment and the result is produced entirely by leakage. This leakage or dissipation into space when the tension is high, is considerable when incandescent lamps are used, and still more considerable with arcs, for the latter act like flames. Generally, of course, the dissipation is much smaller with steady, than with varying currents.



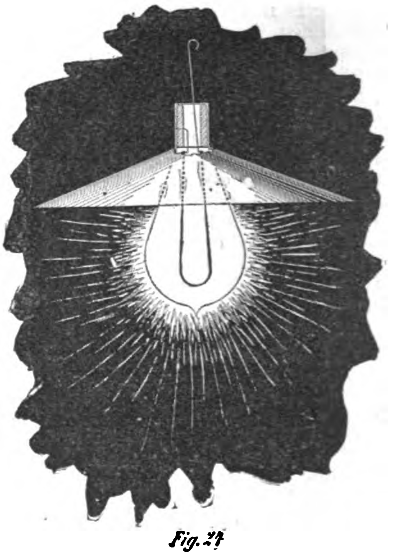


FIG. 23.—CURIOUS INCANDESCENCE OF A WIRE.

FIG. 24.—UTILIZING THE HEATING EFFECT OF CONDUCTION CURRENT AND BOMBARDMENT.

THE WORCESTER CONSOLIDATED STREET RAILWAY CO., of Worcester, Mass., have placed the contract for their new car house with The Berlin Iron Bridge Co., of East Berlin, Conn. The new building will be 95 feet in width and 290 feet in length, entirely of brick and iron.

COLLEGE NOTES.

ELECTRICAL ENGINEERING AT THE UNIVERSITY OF NEBRASKA.

BY

R. B. Owens

WHEN, two years ago, it was decided to establish a course in electrical engineering at the State University of Nebraska, at Lincoln, it was done to fill a growing and pressing need. Though distinctly an agricultural State, it became very evident that Nebraska had other resources than those of agriculture, and to further its industrial progress, it was decided to devote more of the energies of its university to technical work. Accordingly, at a meeting of the Board of Regents, in June, 1891, $15,000 was appropriated with which to procure by careful expenditure such an equipment as with suitable instruction would place the new course on a par with other electrical courses in our oldest and best institutions. To relate how such expenditures were made and something of the course of study laid down, is the object of the present article.

Prior to the establishment of the new course, the Department of Physics, under the very able management of Prof. D. B. Brace, had given special elective courses in applied electricity, which quickly became so crowded as to demonstrate the necessity of establishing a new department. The work of selecting the equipment was begun in the summer of 1891, and all the apparatus excepting the condensing plant was in working order the same year.

The controlling idea in making the expenditures was to have the generating plant fairly represent American engine and dynamo practice at the present time, and to have the measuring instruments of such type that reliable commercial tests might be made of all steam and electrical apparatus on hand. Accordingly, it was decided to have both single cylinder, centre crank, and compound side crank high speed engines arranged to exhaust into the atmosphere or to run condensing, and it was also thought best to use shafting as being a method of transmission still in vogue in many American central stations and as affording a ready means of running several dynamos from one engine.

The dynamos selected cover the most important types in general use, namely, low pressure, constant potential dynamos for the two and three wire systems of direct supply; high pressure, alternating current dynamos for long distance lighting and power; open and closed circuit armature arc dynamos for constant current, together with several inductor machines by Prof. Brace. To these were added 12 transformers of different makes, alternating and continuous current motors and arc lamps, 500 incandescent lamps, an Otto gas engine of 5 h. p., together with a storage battery plant of 75 cells of three different makes, these completing the heavier part of the equipment.

For current measurement by graded instruments, Kelvin balances, Siemens electro-dynamometer and Weston ammeters give a range of from 1 milliampere to 5,000 amperes. For potential measurement by graded instruments electrometers, Weston and Cardew voltmeters and a Kelvin electrostatic voltmeter give a range of reading from a fraction of a volt to 12,000 volts. Electro-dynamometers, wattmeters by Lord Kelvin, Edelman and Siemens, allow of power measurements from a few watts to several hundred thousand. The same range of measurement is provided for in alternating as in continuous currents. Besides the above-mentioned instruments, commercial instruments by the Edison, Thomson-Houston, Ft. Wayne and Westinghouse Co.'s are provided with each system, also the ordinary standard apparatus for magnetic measurements and the measurement of resistance, capacity, inductance, etc., are provided.

For boiler and engine testing, meters, tank and throttling calorimeters, steam, vacuum, and draught gauges, two Tabor steam engine indicators, absorption dynamometers and a transmission spring dynamometer by Van Winkle allow the ordinary tests to be made of boiler and engine efficiency and practice in valve setting, etc.

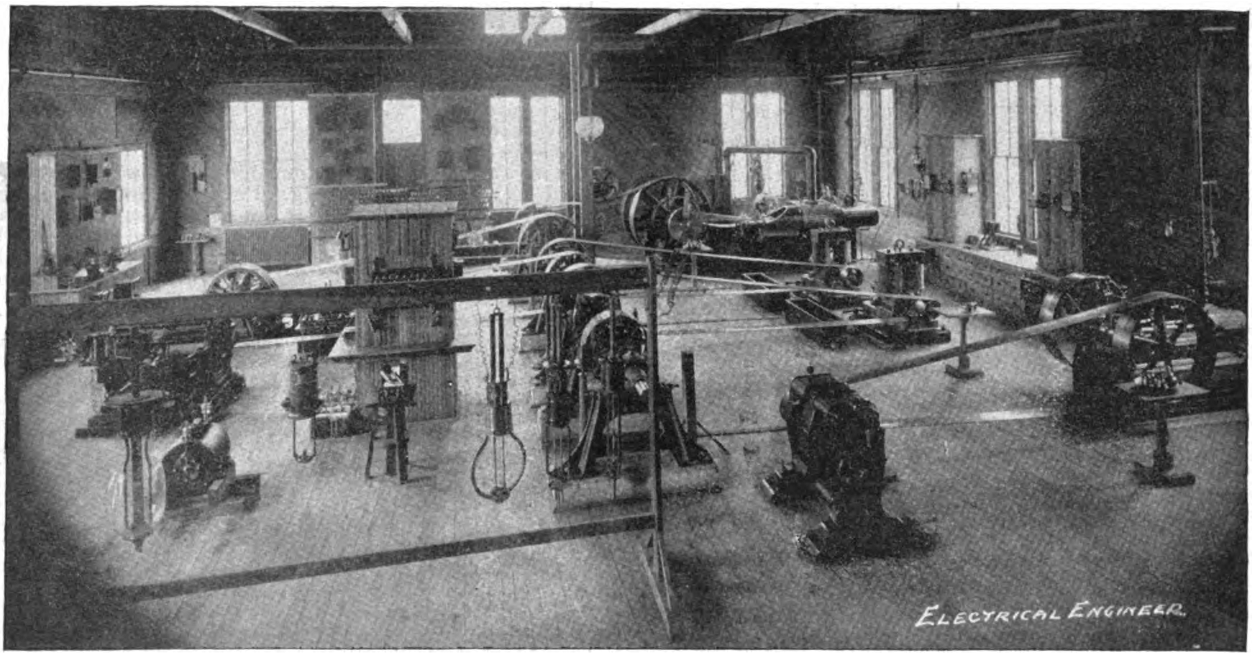


FIG. 3.—DYNAMO ROOM, ELECTRICAL ENGINEERING DEPARTMENT, UNIVERSITY OF NEBRASKA.

The engraving, Fig. 1, shows an exterior view of the electrical engineering laboratory and boiler house. The boiler house is of brick and contains, besides the Stirling boiler for the laboratory, the boilers of the heating plant, feed-water apparatus, coal storage and repair shop. The Stirling water-tube boiler has a grate area of 27 square feet, a heating surface of 1,150 square feet, and is designed to run continuously at a pressure of 150 pounds and to evaporate nine pounds of water from and at 212 degrees F. into steam at 100 pounds gauge pressure per pound of coal. Fig. 2 shows the boiler in position.

The electrical laboratory is built of wood, 50 x 90 feet, with truss roof over machinery, the dynamo-room itself being 50 x 60 feet, and the remaining space being reserved for shop work and drawing. Sufficient funds not being available at first, it was impossible to build of brick, but a wide foundation was left so that the building might be bricked in and the roof covered with iron or slate at as early a date as possible. The foundations for the engine shafting and dynamos are the best possible, being of hard burned red brick and cement mortar resting on heavy footing courses of concrete. Ample light and ventilation are provided by windows on all sides.

The lecture rooms and laboratories for general testing are in the physical building, nearly behind the electrical laboratory and connected with it by cables. Fig. 3 gives a view of the laboratory. The shafting, as shown, is in the centre of the building and on the ground floor, it being thought best not to put it overhead for the double reason of necessitating much more expensive construction of building as well as being less accessible. The shafting, pulleys and floor stands were made by the Falls Rivet & Machine Co., Cuyahoga Falls, Ohio. The shaft is of hammered steel, turned true and polished, $3\frac{15}{16}$ inch in diameter and 33 feet six inches long, in three lengths. Five dynamos are driven from this shaft by clutch pulleys, thus allowing any machine to be started or stopped independently of the others and without shutting down the engine or throwing off belts. The whole shaft can be run from either engine or from both together by means of the cut-off couplings. The first driven pulley from the compound engine is bushed with brass and loose on the shaft, but is attached by a dynamometer of the spring transmission type. This dynamometer, by Van Winkle, is keyed to the shaft, and has four springs, giving a wide range of measurement.

The 10 x 18 x 20-inch compound engine shown at the distant end of the room was made by the Sioux City Engine Co., Sioux City, Iowa, and is designed to run at 125 pounds pressure and 225 revolutions per minute. When indicating 100 h. p. it is guaranteed to show an economy of 25 pounds of steam per indicated horse-power per hour and to regulate within 2 per cent. between no load and full load. The engine has proved very satisfactory in service. The outside fly-wheel of this engine is provided with a two inch internal flange so that a continuous stream of water can be kept flowing on its inner side while an absorption dynamometer is being applied for power measurements.

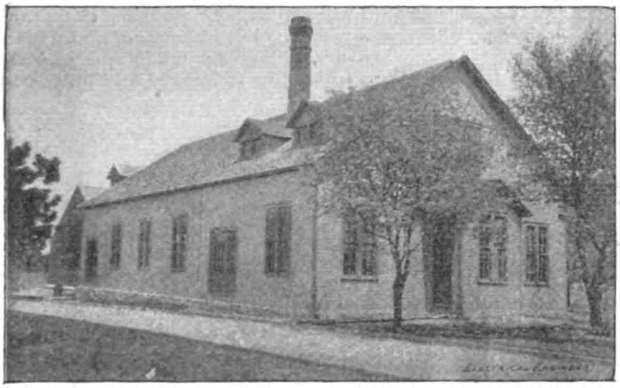


FIG. 1.—ELECTRICAL ENGINEERING LABORATORY, UNIVERSITY OF NEBRASKA.

The exhaust from this engine is carried through a "National" feed-water heater and then may be run into a 100 h. p. Worthington duplex jet condenser, or taken directly out into the atmosphere through a patent Lyman exhaust head. Steam for this engine and the smaller single cylinder engine shown on the same side of the building is brought underground from the Stirling boiler in the boiler house by a six inch lap-welded pipe protected by hair felt and asbestos covering.

The smaller engine shown is an 8 x 12 inch Atlas and runs at 280 revolutions per minute. Being simple and easily taken apart it has proved very useful for giving instruction in indicator practice, valve setting, etc. It may be belted directly to single dynamos or to the line shaft with the larger engine.

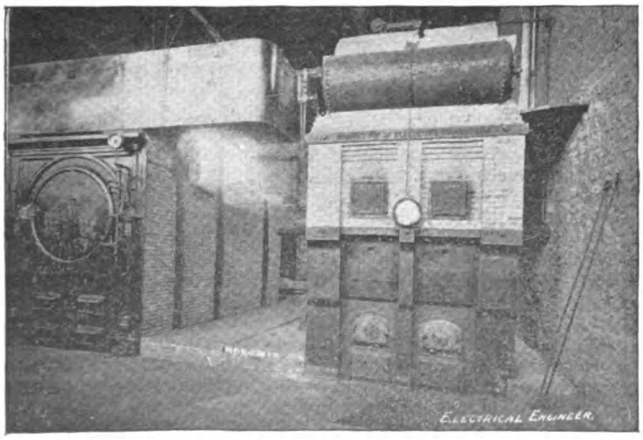


FIG. 2.—THE BOILER ROOM, ELECTRICAL ENGINEERING DEPARTMENT, UNIVERSITY OF NEBRASKA.

To supply water for the condenser, a large cistern holding about half million gallons is being constructed. It is not intended to run the condenser continuously, so that the same condensing water can be used over and over again, time being allowed it to cool down.

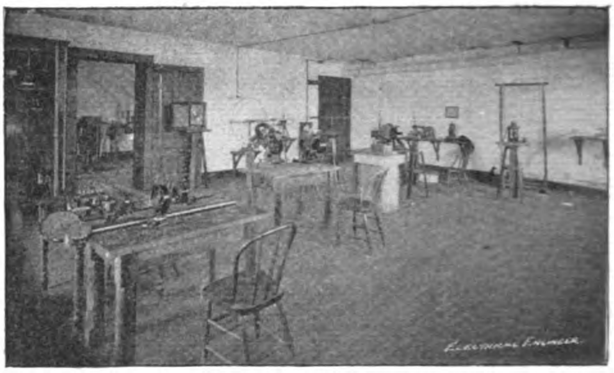


FIG. 4.—ROOM IN ELECTRICAL LABORATORY.

On the same side of the shaft with the two engines are two 15 k. w. 125 volt Edison dynamos running at 1,500 revolutions per minute. These may be run in parallel, or on the three-wire system; also by a special series winding, any degree of compounding can be had. Both being of the same size and their armature shafts parallel, they may be easily coupled mechanically and electrically and their efficiency obtained under various conditions by Hopkinson's method.

The switchboard for these machines is shown opposite them near the east side of the building. Pulleys of different diameters are provided so that characteristics at different speeds may be obtained and other effects of varying speed studied. Both machines are driven by 8-inch double "electric" perforated belts by Chas. A. Schieren, who has also furnished all the other belting used.

The first machine to the left from the large engine is a 1,000 volt 500 light Westinghouse alternator, running at 2,000 revolutions per minute and supplying current to the bank of transformers shown at the north end of the building. This machine is excited by a small United States 110 volt dynamo belted to a pulley on the collector end of the alternator. The switchboard for this machine is shown nearly opposite it and contains the ordinary station instruments of the Westinghouse system. A similar switchboard not shown contains the station instruments of the Thomson-Houston alternating system, and the dynamo can be operated through either switchboard at pleasure.

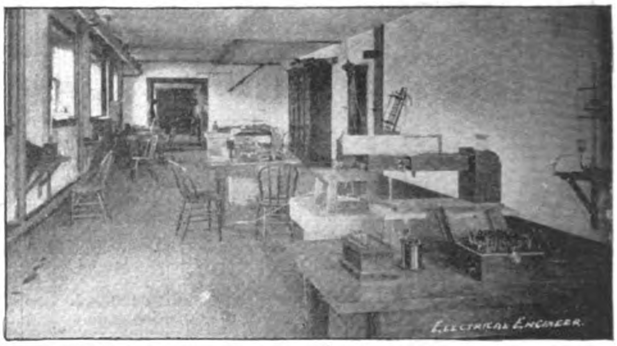


FIG. 5.—GALVANOMETER ROOM, UNIVERSITY OF NEBRASKA.

The bank of transformers shown is made up of Westinghouse, National, Slattery and Thomson-Houston, from 5 light to 50 light, the ordinary sizes used in America for alternating distribution. In the past year a long series of tests of the efficiency of these four types at various loads has been made and the bank of lamps shown under the transformers was used as a non-inductive energy absorbing resistance.

The large machine shown on a line with the Westinghouse is a 25 light, 10 ampere Thomson-Houston arc light dynamo, running at 850 revolutions per minute. This machine, together with a 25 light, 10 ampere Wood arc dynamo, driven by the small engine, is connected through lightning arresters and ammeters to a Foster arc switchboard of four circuits, shown between the Thomson-Houston dynamo and the line shaft. 10 ampere single and double carbon, clutch, ratchet, ribbon, and alternating lamps by the Thomson-Houston, Fort Wayne, Excelsior and Westinghouse Companies, are run from either or both the machines and from the alternator.

As mentioned before, this laboratory is devoted mainly to engine and dynamo testing and the testing of systems as a whole. The more delicate tests, such as those involving the use of reflecting galvanometers, photometer work, etc., is done in the Physical Building. Figs. 4 and 5 show the rooms for general electrical testing. Both rooms have piers separate from the building, on which are placed the more sensitive instruments. The room, Fig. 4, contains the larger number of standard instruments, fixed in position and used for calibrating and the more accurate determinations. That shown in Fig. 5 is devoted more particularly to galvanometer work.

Some of the instruments shown in Fig. 4 are Kelvin balances, electrostatic voltmeter, Kelvin quadrant electrometer, Siemens ammeters and wattmeters, large standard tangent galvanometer by the Troy Electric Manufacturing Company, Obach cosine tangent galvanometer for currents from a fraction of an ampere to several thousand. Magnetometer by Edelman, galvanometer by Queen & Co., earth inductors by Edelman and Queen & Co., resistance boxes by Elliott and Queen & Co., Cardew and Weston voltmeters, standard cells, standard ohms, etc., etc.

The room adjoining that shown in Fig. 4, and partly seen through an open door is devoted to photometric and electro-optical work. The large electro-magnet shown weighs over 1½ tons and is of Norway iron and wound with about six hundred pounds of wire. This electro magnet designed by Prof. Brace and used by him in some recent work, is probably the largest of its kind in this country.

The course of study laid down includes thorough work in mathematics, physics and chemistry, applied mechanics, machine design and steam engineering as a basis for the electrical engineering course. Four years, beginning with the freshman year are required for the Batchelor of Arts degree, the last two years of which are devoted especially to electrical work, such as dynamo machinery, electric lighting, electric railways and power transmission, telephone and telegraph apparatus, etc.

From two to three years are required of post graduate work for the full Electrical Engineer degree.

Throughout the whole work it is attempted to make the student as familiar as possible with the problems he will meet in outside work and to keep him in touch with the latest developments and tendencies. While recognizing the impossibility of imparting to a student in four or six years the kind and amount of knowledge which comes with many years of experience, still it is claimed that such a technical course will increase the immediate earning capacity of the student as well as greatly enhance his chances of rising to eminence in his profession.

ELECTRIC HEATING SYSTEM OF THE AMERICAN ELECTRIC HEATING CORPORATION.

THAT the art of heating by electricity, in almost all its branches, is now no longer an experiment, but an actual commercial success, was abundantly proven a few days ago, when the American Electric Heating Corporation of Boston, gave an elaborate luncheon, all cooked by electricity, to a few members of the electrical press, at the headquarters of their New England sub-company at 629 Atlantic avenue, Boston, and also showed a multitude of household utensils, and other useful contrivances in actual service, heated exclusively by the agency of electricity. Our engraving, Fig. 1, shows an actual picture of a model electrical kitchen, which the company have fitted up in their offices for show purposes, and it was in this kitchen that the lunch referred to was cooked.

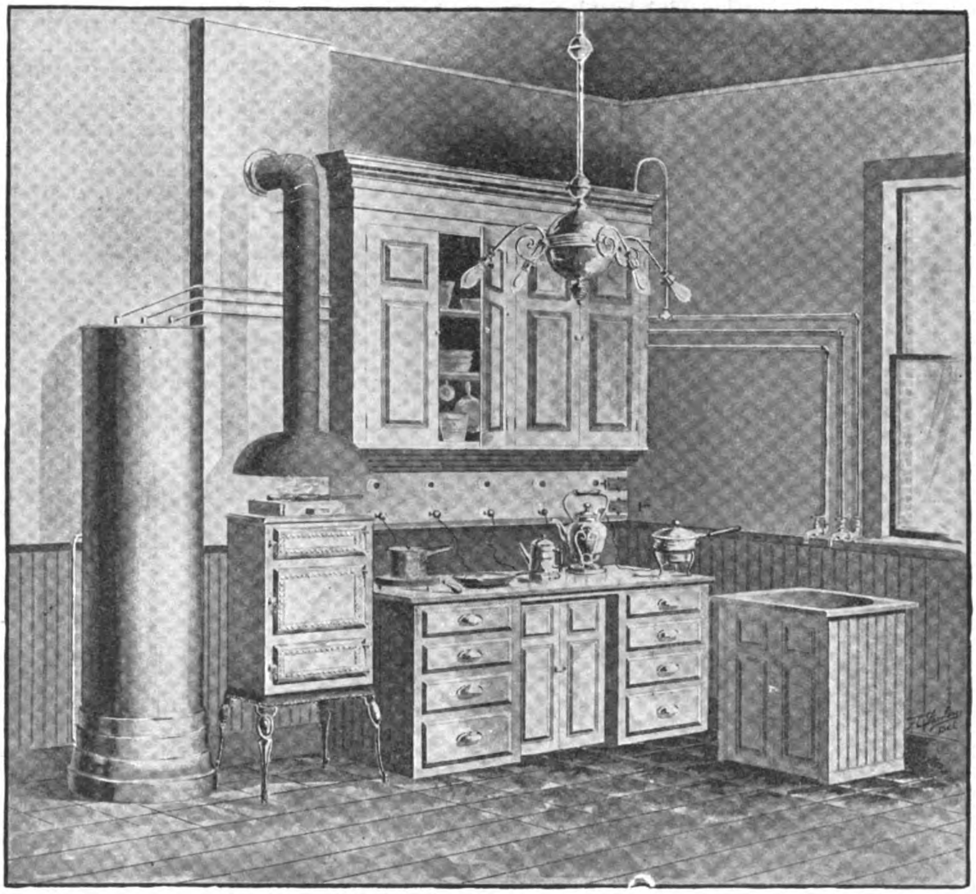


FIG. 1.—A MODEL ELECTRICAL KITCHEN.

The American Corporation were reorganized about three months ago, having been formed from the American Electric Heating Co. which has been in existence for about three years. Very little concerning them, however, has been known to the public, as during these years they have been engaged in perfecting their apparatus, and securing control of all other valuable electric heating patents and organizing sub-companies with territorial rights. These sub-companies are now ready to go into the market and supply apparatus. The American Corporation own some 250 patents, covering almost every known electric heating device in this country, placing them in the position of a parent electric heating company with well-organized sub-companies who will do the actual business of manufacturing and selling electric heating supplies, made under their patents.

Turning once more to Fig. 1, it will be seen that an electrical kitchen is an extremely simple and orderly room, with everything necessary for every kind of culinary operation in its place, and an appropriate place for everything. In the left-hand corner stands a vertical hot water service boiler which supplies hot water, by the pipes running round the wall, to the sink shown at the right

hand of the picture. Next to the heater stands an oven in which various dishes may be cooked at the same time in the two bottom chambers, and plates or food may be kept warm in the upper chamber. On top of the oven rests a broiler which will cook a steak to perfection in a few minutes. The apparatus in the middle of the picture resembling a desk is really the cooking range. It is simply a chest of drawers, with a slate top, on which may be placed half a dozen cooking utensils, such as coffee pot, tea pot, stew pan, sauce pan, pots for boiling vegetables, or, in fact, any cooking utensil required in the preparation of food. Immediately above this is the switchboard, with plug connections and flexible cord, by which attachment may be made to such utensils on the range as are required to be heated. Above this is a cupboard for holding the various utensils when not in use. Everything is neat and cleanly, and electrical cooking becomes simplicity itself. So far as the application of heat is considered it is attended with ease and comfort.

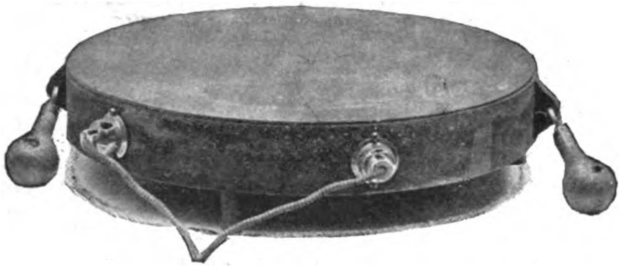


FIG. 2.—ELECTRIC PLATE STOVE.

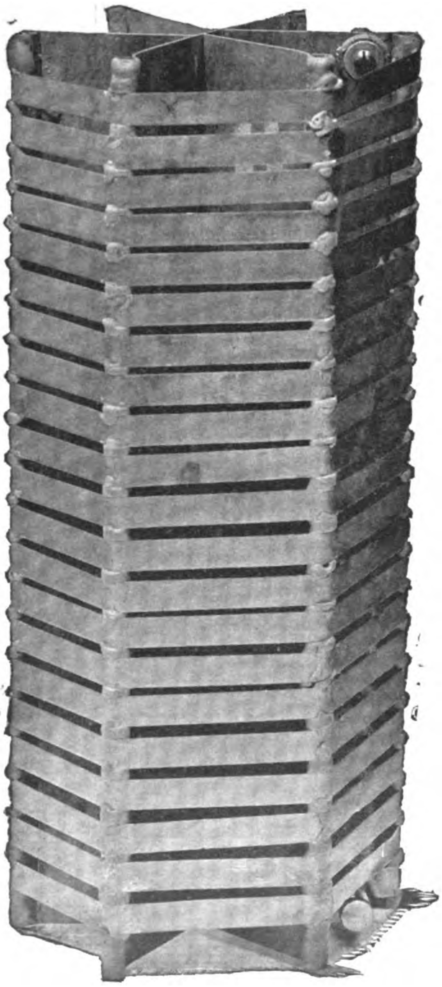


FIG. 3.—COIL HEATER.

It may be interesting to our readers to know the luncheon which was served to the writer and his confrères, and which was all cooked in their presence. First, there was delicious filet de sole with tartar sauce, and biscuit which had been baked in the oven. The French chef in charge of the cooking, stated that he had never been able to procure the uniform brown tint over the fish by any method of cooking hitherto at his command, and the guests certainly agreed that they had never tasted better. Following the fish came lobster à la Newburg, and then the "pièce de résistance" in the shape of a roast sirloin of beef, cooked to a turn, and accompanied by potatoes and green peas. Then black coffee and cigars were served, the latter being lit at an electric cigar lighter, and the exhibition, so far as cooking is concerned, was at an end.

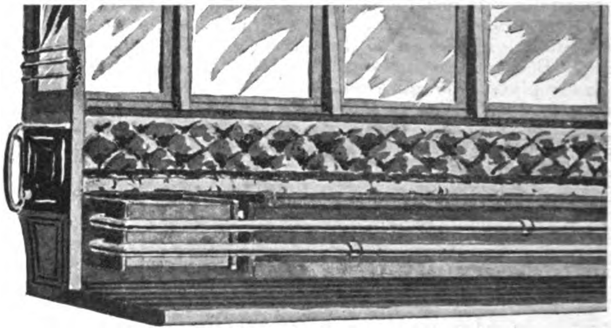


FIG. 5.—CAR HEATING BY HOT WATER CIRCULATION.

The number of different utensils which have been adapted for the use of electricity is very large and it is only possible to illustrate a few of them in this short account. The engraving, Fig. 2, shows a small plate stove, for heating domestic utensils, and the company have also designed a very neat arrangement for a coffee and tea urn. A very handsome catalogue, which they now have ready for distribution shows a multitude of other contrivances, a few of which may be mentioned, such as hot water reservoir, ovens of various styles and sizes, stoves, glue pots, crucibles, muffles, broilers, tea kettles, steam cookers, tea pots, tailors' irons, curling iron heaters, coffee pots, etc.

In Fig. 3 is shown a coil heater open. This system is applied to house heating, and the cut shows one of the styles of the winding used. It will be noticed that the resistance is in the shape of a ribbon, as that form has been found by experiment to be best adapted for this purpose.

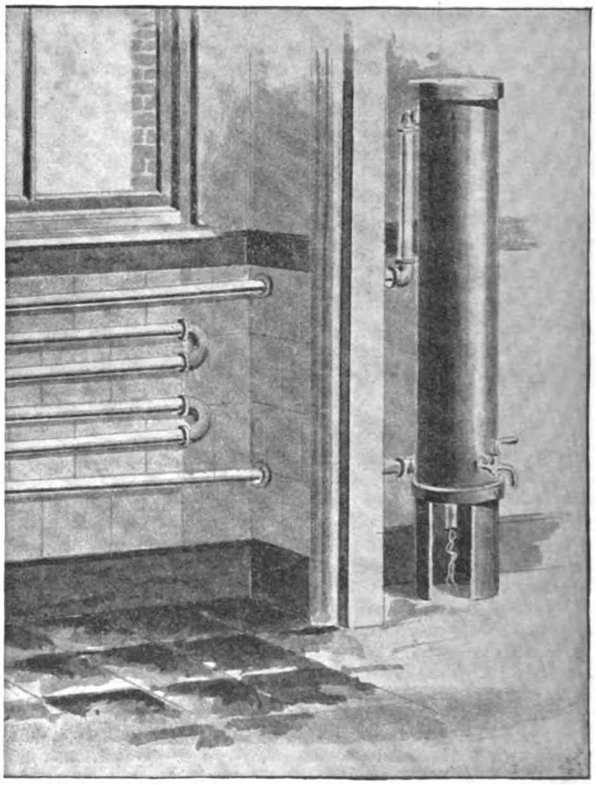


FIG. 4.—ELECTRIC HEATING BY HOT WATER CIRCULATION.

In addition to the supply of household utensils, and such small apparatus as flat irons, soldering irons, crucibles, etc., the American Heating Corporation, have devised and perfected an electric heating system by hot water circulation, for office and house use, a representation of which is shown in Fig. 4. The heater, as will be seen, stands in any convenient corner and acts in the same

way as a furnace would do to heat water which flows out at the top of the heater through the pipes and returns by the bottom pipe to be reheated. In Fig. 5 is shown a section of a car heated by the thermal system, which the American Corporation now controls, and of which a full description was given in our issue of April 19, and which has proved very successful in practice.

In conclusion, it may be stated that there is no problem in heating that the sub-companies of the American Electric Heating Corporation are not prepared to meet and solve, in addition to what they have already done. They are prepared to supply electric heating apparatus in any quantity, and they will contract for the complete electric heating of buildings, ships, houses, electric street cars, or, in fact, any place where artificial heat is required. The headquarters of the American Electric Heating Corporation, which is capitalized at $5,000,000, are at No. 274 Purchase street, Boston. Mr. Edward Jewell is president, and Mr. Arthur B. Smith, treasurer, both gentlemen being well known and successful business men of Boston. The list of directors embraces the following gentlemen: A. M. Dodge, New York; H. C. Duell, Syracuse. N. Y.; Ambrose Eastman, Boston; Frederick D. Hager, St. Paul; Edward Jewell, Boston; A. B. Smith, Cliftondale, Mass.; Charles Odell, Salem, Mass.; J. F. Tams, New York.

The sub-companies operating under the patents of the American Electric Heating Corporation, are: For the New England States, the New England Electric Heating Company, with offices at No. 629 Alantic avenue, Boston; and for the Middle States, the Central Electric Heating Company with offices at 26 Cortlandt street, New York. Other sub-companies are being organized for the Central States, the Western States and for the Pacific Coast.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JUNE 6, 1893.

Alarms and Signals:—

Electrical Transmitter for Telemeter Systems, C. W. Ayton, New York, N. Y., 498,871. Filed Feb. 10, 1892.

Receiver for Telemeter Systems, C. W. Ayton, New York, N. Y., 498,872. Filed June 7, 1892

Operative in full over a single main line with ground return.

Non-Interference Signal Box, C. E. Ongley, New York, N. Y., 498,987. Filed Jan. 19, 1891.

Specially adapted for fire alarms.

Electric Signal and Protective System, C. E. Ongley, New York, N. Y., 498,988. Filed Jan 21, 1891.

A combination of time signals and fire alarms.

Electrical Call Box, W. F. Banks, Milford, Conn., 499,003. Filed Nov. 25, 1892.

Electric Time Signal, G. W. Van Vianen, Cologne, Germany, 499,062. Filed Aug. 2, 1892.

Conductors, Conduits and Insulators:—

Insulated Conductor, T. F. Attix, Brooklyn, N. Y., 498.757. Filed Dec. 1, 1892.

Designed to be fire and waterproof.

Clamp for Electric Conductors, A. H. Englund, Chicago, Ill., 498,776. Filed June 29, 1891.

Wire Coupling, J. Bodine, Pittsfield, Ill., 499,090. Filed Nov. 29, 1892.

Dynamos and Motors:—

Electromotive Device, R. Callender, Brantford, Can., 498,763. Filed July 14, 1892.

For controlling and regulating a reciprocating motor.

Dynamo-Electric Machine, W. S. F. Dillon, Chicago, Ill., 498,969. Filed Nov. 21, 1892.

Details of construction. Designed to cheapen cost and facilitate repairs.

Electro-Dynamic Machine, O. Dahl, Paterson, N. J., 499,099. Filed Oct. 21, 1890.

A slow-speed motor adapted to be placed directly on the driving axle of slow-running machines.

Friction Clutch for Electric Motors, O. Dahl, Paterson, N. J., 499,183. Filed Oct. 26, 1892.

Electrolysis:—

Electrolytic Apparatus, T. Craney, Bay City, Mich., 498,768. Filed March 25, 1892.

For the decomposition of metallic salts.

Method of Electrolyzing Salts, T. Craney, Bay City, Mich., 498,769. Filed Aug. 10, 1892.

Electrolytic Apparatus, T. Craney, Bay City, Mich., 498,770. Filed Aug. 18, 1892.

Relates to the construction and arrangement of a series of cells adapted to produce a cumulative effect.

Electrolytic Cell, T. Craney, Bay City, Mich., 498,771. Filed Oct. 10, 1892.

Lamps and Appurtenances:—

Lamp Socket and Key Holder Therefor, P. Ball and A. Metzger, Schenectady, N. Y., 498,758. Filed August 2, 1892.

Electric Illuminating Apparatus, E. A. Colby, Newark, N. J., 498,878. Filed Feb. 15, 1893.

An incandescent lamp of which the filament constitutes a closed circuit and is rendered incandescent by the induced current caused by a varying field of force. See p. 588, this issue.

Method of Electric Illumination, E. A. Colby, Newark, N. J., 498,879. Filed Feb. 15, 1893.

Amplification of the next above.

Incandescent Electric Lamp, A. De Lodyguine, Paris, France, 498,901. Filed March 11, 1892.

Claim 1 follows:

An incandescent electric lamp having leading-in wires of iron, steel or their alloys, hermetically sealed into the glass bulb of the lamp, by a glass seal containing compounds of boron.

Electrode for Electric Arc Lamps, S. Heimann, New York, N. Y., 498,915. Filed Oct. 24, 1892.

Provided with a refractory coating composed of a mixture of calcined soapstone, water-glass, oil and lamp black.

Electrode Glow Lamp, E. A. Colby, Newark, N. J., 498,929. Filed Feb. 15, 1893.

Amplification of No. 498,878 above.

Electric Illuminating Apparatus, E. A. Colby, Newark, N. J., 499,097. Filed Feb. 15, 1893.

Further amplification of the same.

Metal Working:—

Metal Working, E. E. Ries, Baltimore, Md., 499,040. Filed Dec. 3, 1890.

Adapted for welding together sections of pipe, electric conductors or other continuous-line structures while they are being placed in position.

Miscellaneous:—

Rheostat, E. R. Knowles, Middletown, Conn., 498,799. Filed Jan. 9. 1893.

Claim 1 follows:

A rheostat comprising a plurality of insulating heat-resisting cylinders, a helical coil of wire encircling each cylinder, said coils being connected in series, and one or more movable bridges to connect adjacent coils between their ends.

Electrical Switch, J. Des Brisay, New York, N. Y., 498,880. Filed Nov. 23, 1891.

A "snap" switch.

Electrical Condenser, W. Stanley, Jr. and W. B. Tobey, Pittsfield, Mass., 498,907. Filed Jan. 9, 1892.

Claim 1 follows:

A condenser composed of sections separately encased in boxes of heat-conducting material, contained in a main box or casing with air spaces between, the main box being provided with openings for securing ventilation.

Method of and Apparatus for Electric Perforating, D. M Evanston and J. H. Garnett, Chicago, Ill., 498,973. Filed Feb. 14, 1893.

For writing, tracing, drawing, embroidery and the like.

Railways and Appliances:—

Closed Conduit for Electric Railways, C. J. Kintner, New York, N. Y., 498,852. Filed June 27, 1892.

Relates to the type of conduit railways known as the closed conduit system, in which the main conductor is inclosed in an insulating conduit and in which sectional feeders are connected to the main supply conductor, and disconnected, by the passage of a car.

Railway Signal, J. W. Steele, Chicago, Ill., 498,864. Filed Oct. 5, 1891.

Utilizes the spring of the rails upon the road-bed, caused by the passage of a train, to actuate a semaphore.

Railway-Signal, J. B Stewart, Haverstraw, and W. G. Wattson, Tappan, N. Y., 498,865. Filed May 3, 1892.

For signaling at tunnels especially.

Conduit Railway-Trolley, M. H. Smith, Halifax. Eng., 498,906. Filed April 6, 1886.

Claim 1 follows:

In an electric railway or tramway system the combination with the car, of conductors and collectors and an automatically detachable articulated or flexible connection between the conductor and car.

Trolley Stand, J. R. Griffiths, Chicago, Ill., 498,932. Filed July 2, 1892.

Electric Railway Trolley, J. R. Griffiths, Chicago, Ill., 498,933. Filed July 6, 1892.

An extensible trolley-pole.

Mechanism for Transmitting Power from Car Wheel Axles to Dynamos Within The Car, M. Moskowitz & S. Young, Newark, N. J., 498.985. Filed Dec. 6, 1892.

Trolley Wire Finder, J. Chase, Rochester, N. Y., 499,095. Filed Jan. 28, 1893.

Overhead Electric Railway, J. C. Henry, New York, N. Y., 499,112. Filed Sept. 3, 1890.

Claim 1 follows:

In an electric railway, parallel aerial wires suspended over the roadway, said wires carrying current of different signs, one of said wires being located above and acting as a guard to protect the other.

Electric Railway Trolley, G. W. Hooper, Rochester, N. Y., 499,115. Filed Aug. 10, 1892.

Electric Signal Apparatus and System, J. W. Lattig, Easton, Pa., 499,125. Filed April 12, 1893.

Relates to an automatic block-system for railways.

Electric Signaling Apparatus and System for Railways, J. W. Lattig, Easton, Pa., 499,126. Filed Feb. 21, 1893.

Employs an electric motor for actuating signals in a block system.

Trolley Wire Support, C. Peterson, Brooklyn, N. Y., 499,143. Filed Dec. 16, 1892.

Trolley Wire Curve, R. M. Hunter, Philadelphia, Pa., 499,167. Filed Feb. 2, 1893.

Telegraphs:—

Copying Telegraphic Apparatus, S. P. Denison, Belleville, N. J., 498,911. Filed Feb. 1, 1893.

An autographic telegraph.

Telephones and Apparatus:—

Telephone Switchboard Annunciator, F. R. McBerty, Downer's Grove, Ill., 498,808. Filed Oct. 29, 1892.

Adapted to be readily removable from a switchboard for adjustment or repair.

Telephone Handle or Holder, B. M. Wilkerson, New York, N. Y., 498,869 Filed April 14, 1891.

Telephone, B. Pickering, Dayton, O., 498,919. Filed Oct. 4, 1880.

A magneto telephone.

Telephone, E. M. Harrison, Fort Smith, Ark., 499,108. Filed May 31, 1892.

Includes a microphone, magneto-call box and other telephonic devices.

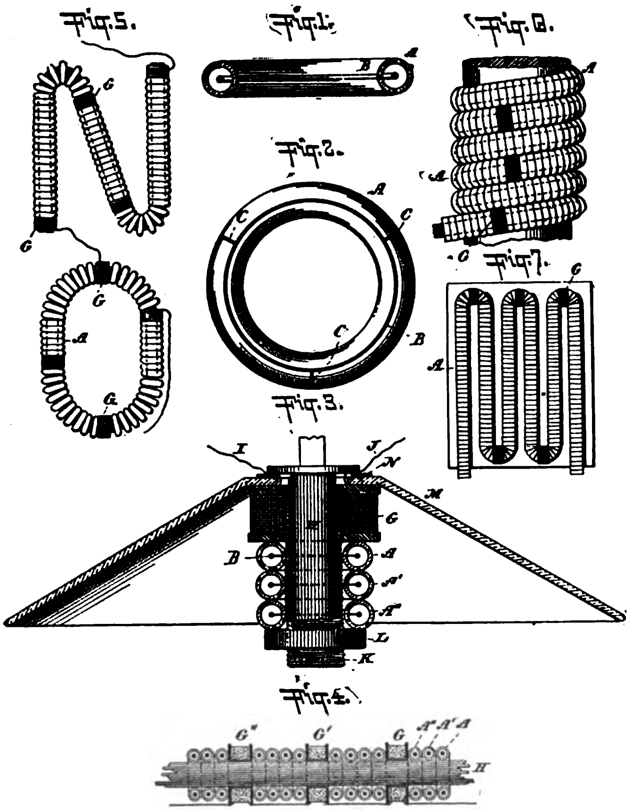
THE ALLEGED THEFT OF WESTINGHOUSE BLUE PRINTS.

A SPECIAL dispatch from Pittsburgh of June 7, says: "The Grand Jury has returned true bills for conspiracy against C. A. Coffin of Boston, President of the General Electric Company; W. J. Clarke of Lynn, Mass., manager of the Railway Department; Milton H. Hamilton of New York, E. W. Rice, Jr., of Lynn, and H. W. Knight of Boston. All these gentlemen are officials of the General Electric Company. True bills were also found against Morris W. Mead, Superintendent of the Bureau of Electricity in this city, for conspiracy, and against C. E. Christian, John Butler and Frank Carey, former employees of the Westinghouse Company, for conspiracy and larceny. It is alleged that the defendants conspired to secure blue prints and tracings showing the design and construction of certain machinery owned by the Westinghouse Electric Company."

PATENT NOTES.

COLBY'S NEW INCANDESCENT LAMP.

We have already illustrated a number of methods and devices intended to introduce novel features in the incandescent lamp, and the most recent of these is that embodied in a series of patents issued last week to Mr. Edward A. Colby, of Newark, N. J. The principle involved in Mr. Colby's lamp consists in so arranging the filament that it shall constitute a closed circuit, this closed circuit filament being rendered incandescent by induced currents generated in it by the influence of a varying magnetic field; in other words, the filament becomes the secondary of an induction coil or transformer, the primary being in connection with the external circuit.



Colby's Closed Circuit Filament Lamp.

One of the methods of carrying out this ingenious plan is illustrated in the accompanying engravings, Figs. 1, 2 and 3, which show such a lamp in various views. The lamp consists of a circular glass tube A, within which a carbon filament B is fixed, held in place by supports of platinum wire. These platinum wires, however, are not leading-in wires as the filament is completely closed and insulated within the tube. By placing the lamps in a varying field of force, created by a primary induction coil G, Fig. 3, connected to the external source of current, the filament is brought to incandescence. The core of the induction coil H, is made of a bundle of straight wires and protrudes beyond the primary coil.

When it is desired to increase the intensity of light the lamps A may be multiplied as represented at A', A'', or, by still farther prolonging the core H and placing upon it several primaries G, G', G''. With lamps placed between them, as shown in Fig. 4, a continuous bar of lamps, as it were, may be constructed. In this way the illuminating source may be made of indefinite length and by making the core flexible by using a wire rope, for instance, novel and striking effects may be obtained. Thus, a "rope of light" may be taken entirely around the room like a molding, or may be bent into ornamental designs or letters as shown in Fig. 5. Again by coiling the "rope of light" around the support, pillars or blocks of any size, Fig. 6, may be devised. Fig. 7 shows the rope in a flat coil by which large areas may be rendered brilliantly glowing.

Mr. Colby proposes to make all the surfaces of the support which are covered by the lamps reflecting, either by silver or nickel-plating or by interposing mirrors. By dividing the filament up into sections of high and low resisting material as shown in Fig. 2, any one, or all, of the sections can be made to glow as desired. In this way the brilliancy of any section can be regulated as desired. It is also evident that the brilliancy of the lamps can be readily regulated by various means depending upon the core, which can be drawn in or out of the lamps and thus influence the inductive action on the closed circuit filaments.

LEGAL NOTES.

A DECISION FOR THE AMERICAN BELL TELEPHONE COMPANY.

American Bell Telephone Co. *et al* }
vs. } No 20. May Term.
McKeesport Telephone Co. *et al.* } In Equity.

UPON MOTION FOR A PRELIMINARY INJUNCTION.

Acheson, *Cir. J.*

Alexander Graham Bell's second patent No. 186,787, dated January 30, 1877, here sued on, was sustained by the Supreme Court of the United States in the Telephone cases 126 U. S., as to the third, fifth, sixth, seventh and eighth claims. Now that decision must be regarded as conclusive upon the present motion for a preliminary injunction. American Middlings Company *vs.* Christian 3 B. & A. 42, 51. American Bell Telephone Company *vs.* Southern Telephone Company, 34 Fed. Rep. 795.

Infringement by the defendants of said claims is, I think, clearly shown. Indeed in the affidavits submitted on the part of the defendants it is not alleged that the telephones used by them differ materially as respects the features here complained of from the telephones which were adjudged by the Supreme Court to infringe the patent.

A preliminary injunction therefore must be granted against the McKeesport Telephone Company and the other defendants who are citizens of Pennsylvania.

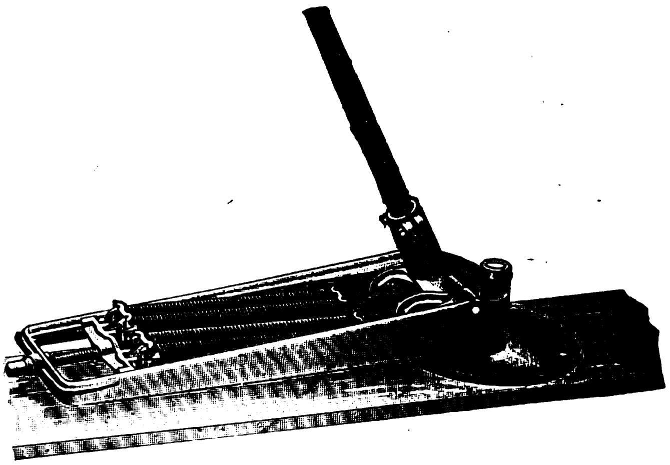
SUITS UNDER THE EDISON LAMP PATENT.

Three test suits were brought in the United States Circuit Court on June 5 by the Edison Electric Light Company and the Edison Electric Illuminating Company under the permanent injunction against the United States Electric Lighting Company and the Sawyer-Man Company, restraining them from using a lamp of the incandescent kind, which, it was claimed, was an infringement on the patent obtained by Thomas A. Edison in 1879.

The suits now begun were directed against Robert Goelet, Ogden Goelet, Robert Stafford, and Henry P. Whittaker as owners of the Imperial Hotel; William Zinsser, owner of the property at 15 Spruce street, and Mary J. Van Doran, Holland House Company, Herbert M. Kinsley, and Gustave Baumann, owners and managers of the Holland House.

THE "PIVOTAL" BOSTON TROLLEY.

We illustrate in the accompanying engraving a new form of trolley, recently put on the market by Messrs. A. and J. M. Anderson, of Boston, which they have termed the "Pivotal Boston Trolley." The Boston trolley made by this company is already well-known and deservedly popular, and the new trolley embodies all its good qualities. It differs from the latter in one point of construction, as its side motion is made on a vertical pivot, thus permitting it to be swung around on the car. The entire base pole and fork is made of steel, and is neat, light and strong. The highest point on the base when the pole is laid down horizontally is but six inches above the car, occupying but little room. The arrangement of the springs is similar to that of the Boston trolley, and is sufficient to insure efficient action without danger of setting or breaking.



The "Pivotal" Boston Trolley.

Trade Notes and Novelties

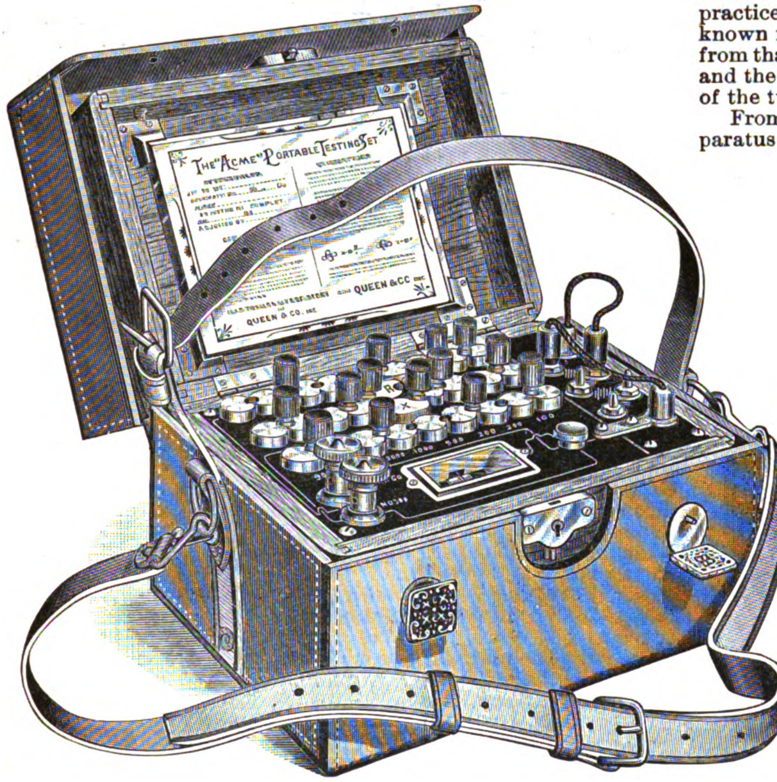
AND MECHANICAL DEPARTMENT.

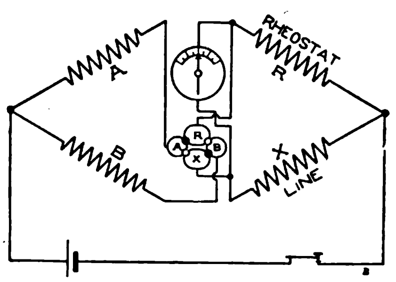
THE "ACME" PORTABLE TESTING SET.

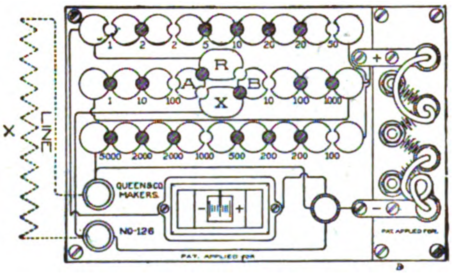
The rapid and correct measurement of resistance under varying circumstances is an important factor in electrical engineering, and for this purpose it is highly essential to use apparatus that properly meets the requirements of everyday practical work.

In this connection the "Acme" portable testing set, illustrated in the accompanying engravings, deserves more than passing notice. As its name implies, it is claimed to be the most perfect commercial instrument for testing resistance yet placed on the market. It embodies the result of long experience on the part of Messrs. Queen & Co. in manufacturing such goods, and will be recognized as even more complete, compact and convenient than their previous sets, which have met with much favor wherever used.

It comprises a Wheatstone bridge, rheostat, d'Arsonval galvanometer, "Aluminum-Iodine" battery and double contact key, all contained in a handsome mahogany case of 8¼ x 5⅜ x 5 inches outside dimensions, and weighing less than six pounds complete. The leather case illustrated in Fig. 1 is very convenient when the apparatus is used by inspecting engineers, as it can be slung over the shoulder and carried as readily as a small hand bag.


THE "ACME" PORTABLE TESTING SET
QUEEN & CO.





FIGS. 1, 2 AND 3.—THE ACME PORTABLE TESTING SET.

The coils in both bridge and rheostat are wound with the celebrated platinoid wire which long use has conclusively shown to be far superior to German silver, and adjustments are made with great care, an accuracy of one-fifth of one per cent. being guaranteed. The arrangement is similar to the "Post Office" design, with three coils in each bridge arm and 18 coils in the rheostat, giving a total range by means of the reversing attachment of from .001 ohm to 11,110,000 ohms.

The galvanometer is a modified form of the d'Arsonval type, made specially for the purpose, and proves far superior for actual testing to other styles. It is strongly built, hence not liable to injury, and is perfectly dead-beat, so that readings can be taken very rapidly. External magnetic fields and mechanical vibrations produce no effect whatever, and the instrument will give as accurate indications in the street, on ship board or in a dynamo-room as in a college laboratory. This feature, possessed by no other make of similar apparatus, should not be overlooked.

The battery is of the new "Aluminum-Iodine" form with an E. M. F. of $1\frac{4}{10}$ volts per cell, or equivalent to a total of 17 volts; this is practically 50 per cent. more than the ordinary chloride of silver cells. Should the battery be exhausted from long use, it can readily be removed from the box and renewed at slight expense.

The apparatus complete is shown in Fig. 1, while Figs. 2 and 3 indicate the arrangement of working parts. In Fig. 2, A and B represent the two proportional bridge arms; R is the adjustable rheostat, and X the unknown resistance or line. In Fig. 3 the arm A of Fig. 2 is equivalent to the coils 1, 10, 100 on the left hand centre row, and the arm B to the coils 10, 100, 1,000 on the right hand of the same row. The rheostat R corresponds to the coils of the top and bottom rows, aggregating 11,110 ohms, and X, the unknown quantity, is connected between the two binding posts at the lower left hand corner.

In Fig. 3, the blocks marked A, R, B and X are connected to the bridge arms and are the same as shown in the centre of Fig. 2. They constitute the "reversing arrangement" whereby the bridge arms may be interchanged and six coils be made to do the work of eight. Thus, when one plug is placed between A and R and another between X and B, the order of the arms working clockwise and beginning with R will be, R: X :: B: A. If the plugs are changed so as to connect A to X and R to B, the order will be, R: X :: A: B. By this means it also becomes possible to readily detect inaccuracies in the bridge ratios should any exist, and to eliminate them entirely in work. Thus, if the two 100 ohm coils of the proportional arms are slightly different, this fact becomes evident in practice by reversing and balancing them. If with a given unknown resistance the rheostat has a different value in one case from that in the other, the two bridge coils must be slightly different and the correct value of the unknown resistance will be the mean of the two rheostat resistances used in obtaining the two balances.

From the preceding description it will be evident that the apparatus is remarkably simple in operation, so that an inexperienced lineman can learn to use it in a short time. The great value of such an instrument will be evident to those who have used the forms heretofore obtainable, which usually necessitate the handling of two boxes, one for the rheostat, galvanometer and bridge, and a separate one for the battery.

The manufacturers, Queen & Company, Incor., of Philadelphia, are anticipating a very large demand, and have arranged to turn out the sets in sufficient quantity to fill all orders promptly. They will be pleased to furnish further particulars upon application, and also to forward descriptive circular No. 445, to interested parties.

GEO. L. COLGATE.

MR. GEO. L. COLGATE, lately in the selling department of the C. & C. Electric Co. has recently opened an office of his own in the Electrical Exchange Building, No. 136 Liberty street, New York, where he will carry on the business of manufacturers' agent. Mr. Colgate has already secured agencies for the Whitney electrical instruments, Simplex insulated wires, Commercial dynamos and motors, and a number of other specialties which are recognized as standard.

NEW YORK NOTES.

MR. HENRY G. ISSERTEL, the electrical engineer of Alexander, Barney & Chapin, this city, was married on June 6 to Miss Idabel Blakeman of Brooklyn, at the residence of her parents in that city.

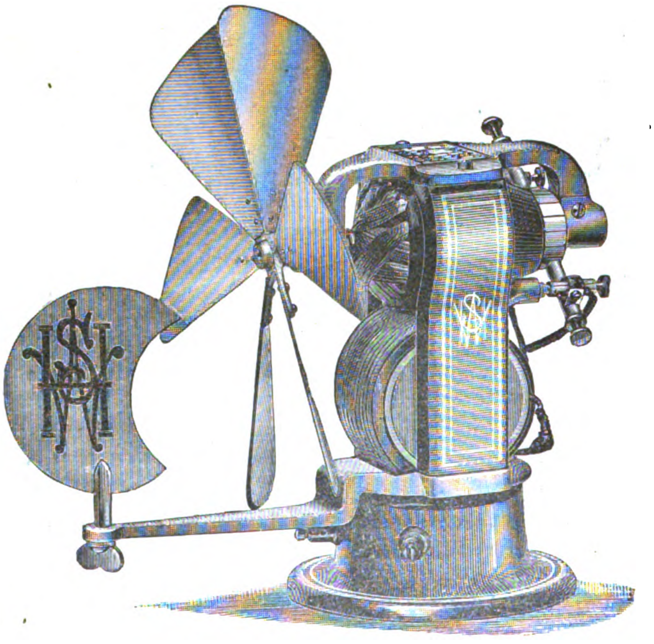
PRACTICAL TEST OF THE FITCH AUTOMATIC ELECTROMAGNETIC SWITCH FOR ELECTRIC RAILWAYS.

SCORES of patented automatic switches have been brought to the notice of railroad men in order to be given a critical examination and practical trial. The usual result of such tests is the finding of grave faults which do not appear to the inventor before the test. If such a mechanism is not perfectly reliable under all circumstances of the intended service it will surely find its way into the scrap-heap to make way for another device, perhaps no better. Automatic switches have been designed for use in connection with electric lighting and power circuits but these do not bear the responsibilities of railroad switches, being of a different nature.

The Fitch switch is a combination of electromagnetic and mechanical devices, the current for operating it being furnished in the ordinary way through trolley and tracks, and needs only superficial attention on the part of the motorman. If placed on an electric railroad a single daily inspection would insure its correct working. A practical test was made of this switch on the Steinway Electric Railroad, in Astoria, Long Island, at the corner of the Boulevard and Fulton avenue, on Thursday, June 8, it being the first one installed. The test consisted of running a special car to-and-fro over the switch and keeping covers open for close inspection by all present. The regular cars of the road ran over this switch all day with satisfaction and during the special tests dozens of regular cars passed. Members of the technical press, and officers of different electric roads, including Mr. Moulton, general manager of the Steinway Railroad; H. J. Hutchinson, general manager of the Broadway Road of Brooklyn; W. R. Lockwood and W. W. Comstock, of the South Orange Electric Railroad; also Mr. C. M. Fitch, the inventor, were present. The general opinion was that the switch had worked most satisfactorily in every respect. The switch is being exploited by the Fitch Excelsior Switch Company, of No. 45 Broadway, this city.

NEW ROTATING FAN MOTOR OF THE W. S. HILL ELECTRIC COMPANY.

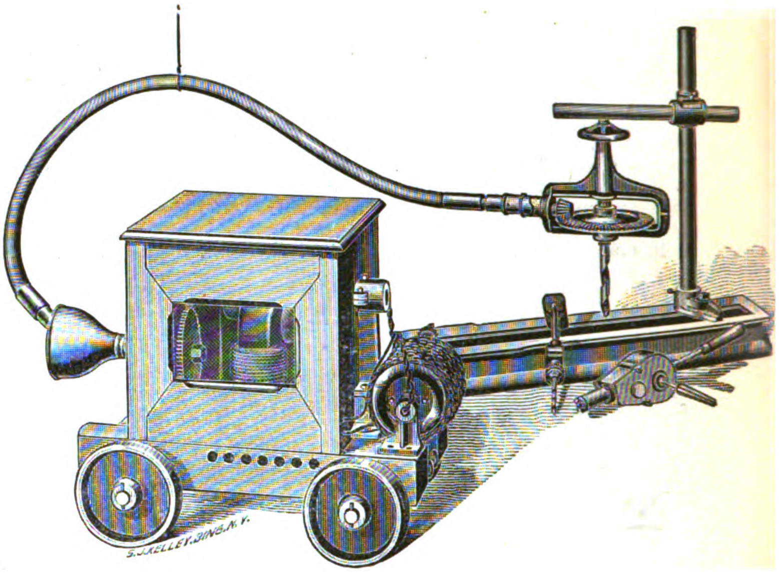
WE illustrate in the accompanying engraving a new rotating fan motor which has just been put on the market by the W. S. Hill Electric Company, of Boston, and which presents a quite novel feature in its method of producing the rotation. The motor itself has been designed after months of constant experiments and is a high-class machine throughout, being practically noiseless, self-lubricating and running perfectly cool. The motor weighs about twenty pounds and has a 12-inch fan, which runs at about 1,500 revolutions per minute on a 110-volt circuit, requiring less than one ampere of current to operate it. The novel feature is the crescent shaped rudder which is attached to the base of the motor and revolves with it. By placing this rudder at an acute or obtuse angle to the direction of the breeze, the motor is made to revolve by the impact of the air on the rudder, the speed of rotation being regulated by the angle of the rudder. By placing the rudder at right angles to the direction of the breeze, no rotation will take place, and the fan can be used as an ordinary stationary fan motor. The design of the rudder for rotation purposes is quite new and very ingenious, and its application has proved very successful, the fan distributing the breeze in all parts of a room evenly and uniformly.



THE HILL ROTATING FAN MOTOR.

STOW FLEXIBLE SHAFT AND ELECTRIC MOTOR.

MANY railroad, machine, boiler and bridge shops have long since been equipped with the Stow flexible shaft for drilling, tapping and reaming, and that tool is now regarded as the standard for this class of work. Recently, however, there has been a tendency among the larger shops to increase the range of operation of the tool beyond that for which it was originally designed. This demand was met by increasing the length of the driving ropes and adding extra idlers to support them; but the just objection has been raised that when traveling cranes or other overhead machinery are used the driving ropes are in the way.


S.J.KELLEY.SING.N.Y.

STOW FLEXIBLE SHAFT AND ELECTRIC MOTOR.

The way out of this difficulty was not far to seek with the electric motor brought in as an intermediary. The accompanying illustration shows the combination of the Stow flexible shaft and a specially designed low-speed electric motor. This outfit embodies a complete electric portable drilling, tapping and reaming plant which can be carried to any distance from the source of power. The motor has a normal speed of 600 revolutions per minute, which can be increased by rheostat to 1,000 and 1,200 or reduced by gearing to 275 revolutions per minute, without loss of power. The motors are wound for a voltage of 110, 220 or 500.

These combination sets are manufactured by the Stow Manufacturing Company, of Binghamton, N. Y.

THE MENOMINEE ELECTRIC AND MECHANICAL COMPANY.

THIS company although but a recent comer into the electrical field is already doing a most prosperous business in the manufacture of the smaller electrical specialties. They are in the market to-day with a very superior fan outfit, two types of which can be supplied on shortest notice. Their No. 1 fan outfit is a very pretty piece of mechanism, nickel-plated, mounted on a highly-polished wood base having rubber cushions. Speed can be adjusted by changing lamps to different voltages. The motor is simple and is made with minute perfection in every detail. The No. 1 carries a $7\frac{1}{8}$-inch fan.

The No. 2 is considerably larger and is intended to develop $\frac{1}{8}$ h. p. It is finished in nickel and beautifully oxidized copper. This motor is a "thing of beauty." It is designed for 100 or 110 volts and has three speeds regulated by a very neat and original switch placed on the top of the motor. The resistance coil is underneath the base and out of sight. The motors are made by the Menominee Electric and Mechanical Company located at Menominee, Mich., who also manufacture an excellent line of switches, annunciators, etc. Mr. Henry Tideman, superintendent and manager, is a man of wide experience in electrical matters and has many interesting inventions that should prove of great advantage to his company. He is a graduate of Germany's best technical and engineering colleges, and though still young has done a great deal of good work.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XV. JUNE 21, 1893. No. 268.

LIEUT. FISKE'S DEPRESSION POSITION FINDER.

We have already described several arrangements devised by Lieut. B. A. Fiske, U. S. N., for determining the range and position of distant objects by the aid of electrical means, and are now able to place before our readers his latest device of this nature. It is intended for use more particularly as a position finder, to be employed on shore, as, for example, in a fortified place at the entrance of a harbor. It enables the position of a ship or other object afloat to be accurately determined, and thus renders it possible to train a gun upon it accurately.

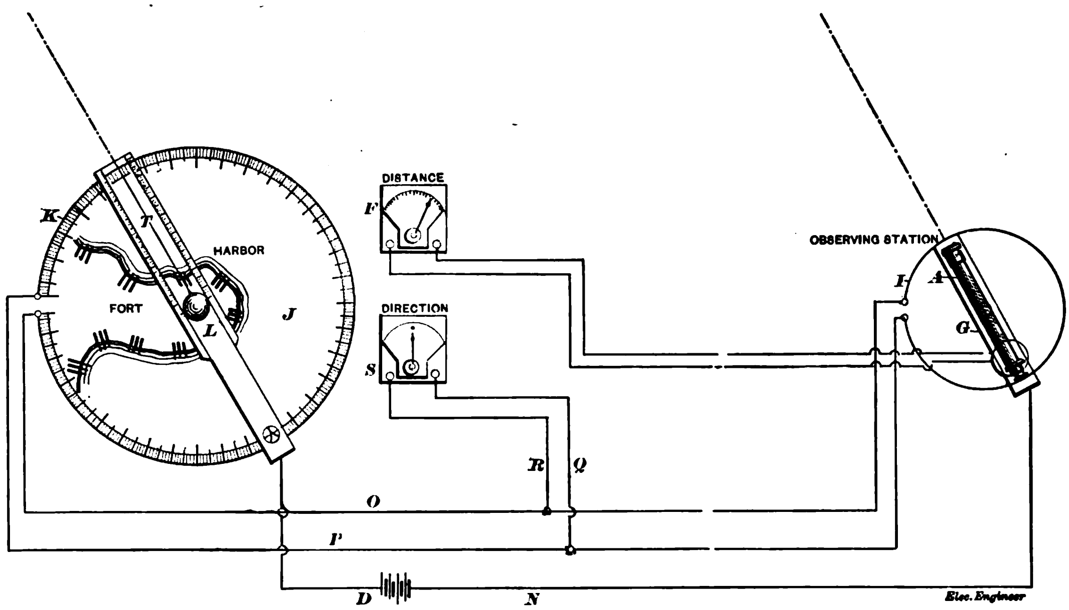


FIG. 1.—DIAGRAM SHOWING METHOD OF OPERATION OF FISKE DEPRESSION POSITION FINDER.

The apparatus consists of two principal parts; namely, a device for determining the distance and a device for determining the direction or bearing of the object. These two parts are used conjointly, and thereby the location of the object may be recognized upon a chart representing the area of the harbor, for example, drawn on a reduced scale. In the accompanying drawings, Fig. 1, is a diagram illustrating the operation of the distance or range finder. Fig. 2 is a diagram illustrating the operation both of the range finder and of that part of the apparatus which shows the bearing of the distant object. Fig. 3 is a side elevation of the observer's instrument and shows the mechanism in detail.

Referring first to Fig. 1, A is a telescope, located upon an elevation adjacent to the waterway to be protected. The telescope is pivoted at its outer end, so that it can be depressed through any desired angle in order to bring it to bear upon the object. It is provided near its sight end with a contact piece or wiper which always bears upon a body of conducting material, represented symbolically at C, Fig. 2. Connected with the ends of the body C is a battery, D, and connected in circuit with one end, E, of C and with the movable wiper or contact piece carried by the telescope is a galvanometer, F.

It will be apparent that as the telescope A is moved on its pivot, its contact piece or wiper will be carried along the body C; and, as a consequence, a greater or less amount of it will be brought into the circuit which includes the galvanometer F. Inasmuch as the body C consists of a wire of uniform resistance per unit of length, it is obvious that as the telescope is moved and a greater or less length of the wire is brought into the galvanometer circuit, the resistance thus interposed in the circuit will be increased or diminished; and as this length, and hence this resistance, depends upon the angle of depression of the telescope, it becomes a function of the angle of depression; and, equally, the deflection of the galvanometer F, due to this change, is also a function of the angle of depression. Therefore, knowing the height of the telescope above the level of the object, the galvanometer deflection will indicate the distance of the object from the telescope, for which purpose the galvanometer may be once for all graduated in any suitable unit, such as metres or yards. Hence, if the galvanometer be located at a station distant from that telescope, an observer at that distant station, by reading the galvanometer, can recognize at once the distance of the object, while the person stationed at the telescope has nothing to do but to keep it properly directed upon the object.

The telescope pivot is carried upon a bar, G, Fig. 3, which is pivoted upon a circular table, H. Placed in a groove around the periphery of this table is a wire, I, Fig. 1, of conducting material, having a uniform resistance per unit of length. Upon the bar G is supported a contact piece or wiper, as will be more particularly explained later, which contact piece or wiper always bears upon the wire I. At the distant station, Fig. 1, there is arranged a circular table, J, having around its periphery a wire, K, similar in all respects to the wire I. Upon this table is pivoted a bar L which carries a wiper or contact point which constantly presses upon the wire K. The contact point on the bar G and the contact point of the bar L are connected by a wire, N, which also includes the battery D. The ends of the wires K and I are connected by wires O and P, and these wires, O and P, are respectively connected to wires Q and R which lead to the terminals of a galvanometer, S.

It will be obvious, by a simple inspection of Fig. 1, that the wires I and K at the separated stations and the pivoted bars G and L, together with the battery and the galvanometer S, are connected in a Wheatstone bridge circuit, and that a movement of either the bar L or the bar G, displacing the contact pieces over the wires K or I, will vary the resistance of the bridge arms, so that the bridge may be brought into or out of equilibrium by the movement of these bars upon their pivots. And further, it will be obvious that the fact when equilibrium is produced in the bridge will be made manifest by the movement of the pointer of the galvanometer S. The construction is such, therefore, and the instruments at the separated stations are placed with reference to one another so, that when the bar L makes the same azimuth angle with reference to one end of its wire K as does the bar G, then the bridge will balance and the galvanometer S will show zero; so that if the telescope A, and consequently the bar G, parallel thereto, be directed upon the object, the galvanometer S will indicate zero when the bar L is placed similarly to the bar G.

If then, on the table J, there be disposed a chart of the area to be protected, on a reduced scale, such, for example, as is shown in Fig. 1, the direction of the object from the point of observation will be indicated by the position of the bar L. For convenience in this respect the bar L is made with an opening containing a longitudinal wire, T; the position of the object on the chart being, of course, along this wire. On the sides of the opening in the bar L there is marked a scale of distances, in yards or metres.

The operation of the whole apparatus will now be readily understood: The telescope A is depressed, and also moved in azimuth, until aligned with the object. Inasmuch as the distance of the object depends, as has already been explained, upon the angle of depression, and as this angle is measured by the galvanometer F in terms of distance, it is plain that if the galvanometer F be located at the station distant from the observer, then from that instrument the distance of the object can at once be read off. Simultaneously the movement of the telescope A in azimuth disturbs the balance of the bridge which includes the galvanometer S. The observer at the receiving station then moves the bar L until the galvanometer S, placed near to him, shows zero. When this is done the position of the object will be somewhere along the line of the wire T; and its exact point along that wire is immediately found by noting on the scale on the bar L the distance corresponding to that shown by the galvanometer F. The receiving stations may be as numerous as desired; in practice, one receiving station is located at each group of guns.

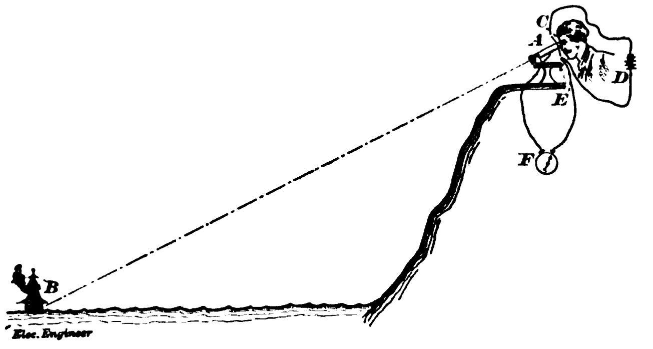


FIG. 2.—FISKE'S DEPRESSION POSITION FINDER.

It will be apparent that one of the great advantages of this instrument is that it is directed by a single observer, and that the simple operation of aligning it with the target instantly causes, at the distant station (the bar L there being suitably manipulated), indications from which the bearing and distance of the object may at once be recognized.

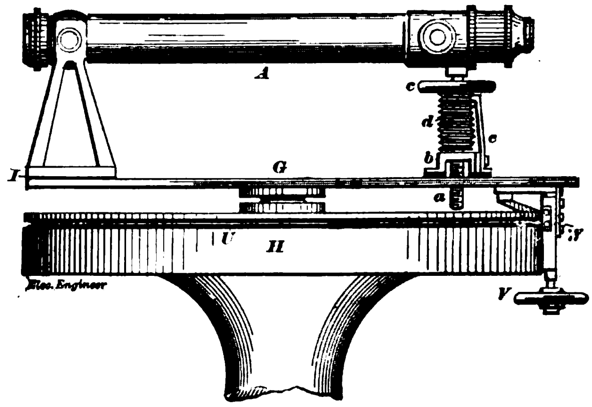


FIG. 3.—FISKE'S DEPRESSION POSITION FINDER.

In Fig. 3 we illustrate, in detail, the mechanical construction of the telescope A and its supports. The table H has imbedded in it a ring, U, of hard rubber, in which ring is the groove in which is placed the wire I. The bar G is rotated on its pivot by means of the handwheel V, the support for which wheel carries the contact point or wiper. The inner end of the telescope A is supported on the vertical screw *a*, which passes through the fixed nut *b*, which is carried on, but insulated from, the bar G; the insulation being placed below the nut. The screw *a* is rotated to depress and lower the telescope by means of the handwheel *c*. Secured upon the screw is a cylinder, *d*, of ebonite, having upon its surface a spiral groove in which is laid the German silver wire corresponding to the body C, Fig. 2. *e* is a contact spring which always bears upon the wire C, and this spring is supported upon, but insulated from, the nut *b*. In this device, instead of causing the telescope A to carry the contact and move it over a fixed body, C, as in Fig. 2, the body C, by the rotation of the screw *a*, is made to move under the fixed contact piece *e*; the relation of the parts being thus merely reversed. The circuit connections are the same as is indicated in Fig. 1; that is to say, the battery terminals lead to both ends of the wire C wrapped upon the cylinder *d*, and the terminals of galvanometer F connect respectively with the contact wiper *e* and one end of the wire C. The movement of the telescope A in azimuth is 350 degrees.

A peculiarity of this instrument is the ease with which it can be adjusted for rise and fall of the tide which causes of course a rise and fall of the vessel; and for changes of refraction. For it is plain that it is merely necessary to have a buoy anchored at a known distance, and to manipulate an adjustable resistance in the galvanometer circuit until the galvanometer indicates this distance, when the telescope is directed on the buoy.

GARBAGE "DESTRUCTORS" AND ELECTRIC LIGHTING.

IT is proposed to employ a six-cell destructor for the purpose of disposing of the refuse of the town of Widnes, England. Among the ways in which the heat thus generated will be utilized, an electrical plant, capable of lighting the town hall, market, free library, technical schools, and part of the street lamps, is included.

A SIMPLE METHOD OF CALCULATING JOINT RESISTANCES.

BY

William C Ramsdell

There are three methods for finding the joint resistance of several circuits or conductors, two of which are well known, but are generally regarded only as empirical laws. They are not empirical in fact, but appear so because of the neglect of writers to give the process by which they are found.

By the first method, when two circuits only are involved, their joint resistance is found by dividing the product of their resistances by the sum; and when more than two circuits are to be considered the joint resistance of any two of them must first be found, and that joint resistance, considered as that of a single circuit, taken with another circuit to find another joint resistance; and so on, until all the circuits have been used, the final quotient being the joint resistance sought. Where more than two circuits are concerned this method is not desirable, because of the multiplicity of fractions resulting and the great liability to error.

Why this method is true may be explained thus:—Given two circuits (call them branch, parallel, or derived circuits, or "multiple arc," as preferred, they are but different names for the same thing)—A and B, of three and four ohms resistance respectively; to find their joint resistance.

For the sake of clearness it may be assumed that both circuits are homogeneous and of equal length, and that the difference in their resistances is due solely to difference in sectional area. As the resistance of a conductor is inversely as its sectional area, it is obvious that A must have a larger sectional area than B. Calling the area of A unity, that of B would be $\frac{3}{4}$. The sum of these areas, $1\frac{3}{4}$, would be the area of a single conductor having a resistance equal to that of A and B, and its resistance would be the quotient of the resistance of B divided by $1\frac{3}{4}$, that is, $3 \div 1\frac{3}{4}$, or $\frac{3}{1} \times \frac{4}{7} = 1\frac{5}{7}$,—the joint resistance of A and B. But the numerators of these fractions are identical with the resistances of the two circuits, and the product of the denominators is the sum of their resistances; hence the rule.

The second, or "reciprocal" method, is more easily understood than the first, and is preferable when the joint resistance of three or more circuits is to be ascertained. The rule by the second method is: Add the reciprocals of the resistance of each conductor and the sum will be the reciprocal of the joint resistance. This is readily understood when it is considered that conductivity is the reciprocal of resistance, and *vice versa*, and that when we add the reciprocals of the resistances we are also adding the conductivities, and that the sum of the conductivities must be the reciprocal of the joint resistance.

Example: Given conductors A, B and C, having respective resistances of 1, 2, and 3 ohms. The sum of their reciprocals, $\frac{1}{1} + \frac{1}{2} + \frac{1}{3} = \frac{11}{6}$, which is also the sum of their conductivities and the reciprocal of the joint resistance. Therefore the joint resistance is $\frac{6}{11}$ ohm.

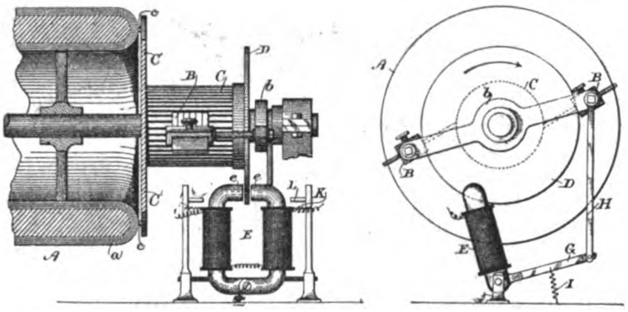
The third method, which, so far as the writer can learn, has never been published, is on some accounts preferable to either of the others. By it the joint resistance is found by dividing an assumed E. M. F by the sum of the currents which would be produced by it in the given conductors, thus using nothing but the law of Ohm. The calculation is simplified by assuming an E. M. F. which is a common multiple of the resistances.

Example: Given conductors A, B, C, D and E, with resistances of 2, 3, 4, 5 and 6 ohms, respectively; to find their joint resistance.

The least common multiple of these resistances is 120. Assuming an E. M. F. of 120, there would be a current of 60 amperes in A, 40 in B, 30 in C, 24 in D, and 20 in E. The sum of these is 174, and $120 \div 174 = \frac{20}{29}$, which is the joint resistance of the five conductors. The superiority of this method will be quickly seen when the attempt is made to find the joint resistance of these conductors by either of the old methods.

HENRY'S REGULATOR FOR CONSTANT CURRENT MOTORS.

In a patent just issued to Mr. John C. Henry, that well-known inventor describes an interesting device for automatically governing the speed of constant current series motors. The method employed is illustrated in the accompanying engravings, Figs. 1 and 2. Mr. Henry winds the armature with flat wire *a*, and the commutator bars C carry sharp points *c*, which embed themselves in the wire and so make superficial contact therewith at the proper points. The brush yoke *b* is free to turn around the shaft to change the position of the brushes. Secured upon the shaft is a disc D of diamagnetic metal, such as copper. Below the disc is arranged an electromagnet E, hinged at its lower end and having polar projections *e* embracing the edge of the disc D. When used with a constant current motor the magnet coils are placed in shunt with the armature of the motor terminals, preferably the former. When used on a regulator for generators, the magnet coils are in series with the armature. Secured to the magnet is an arm G, the extremity of which is connected by a link H with the yoke *b*. A spring I tends to hold the arm normally in a horizontal position.



Figs. 1 and 2.—Henry's Constant Current Motor Regulator.

When the motor is started and the copper disc is rotated, the currents generated in the copper disc rotating between the poles *e* tend to drag the magnet along with the disc which results in tilting the magnet to one side and thereby rocking the yoke *b*, as shown in Fig. 2. As the angular movement of the magnet and yoke depends upon the speed of the armature and the strength of the magnet, it follows that any variation from the normal speed is followed by a compensating movement of the brushes.

INFLUENCE OF MAGNETIZATION ON E. M. F.

M. Chassagny has a note in the current number of the *Comptes Rendus* on the influence of longitudinal magnetization on the E. M. F. of an iron-copper thermo-electric junction. Two couples were used, one being in the axis of a long magnetizing helix, so joined together that they acted in opposite directions. The results obtained were:—(1) The effect of longitudinal magnetization is always to increase the E. M. F. (2) This increase is independent of the direction of magnetization. (3) For increasing fields the increase is at first very nearly proportional to the strength of the field, and attains a maximum value of 6.1 microvolts for a field of 55 C. G. S. units. After this it slowly decreases till for a field of 200 units it is 3.2 microvolts.

THE ELECTRIC LIGHTING PLANT OF THE HOTEL WALDORF, NEW YORK.

ONE of the most interesting isolated plants in New York City is the electric light installation in the new Hotel Waldorf, which embodies many of the latest advances that have been made in electrical engineering; the desire of the builders being to have a plant which would be well up to the high-class level of the general equipment of the hotel, as it is one of the finest hotels in the country.

The Waldorf occupies the northwest corner of Thirty-third street and Fifth avenue, and covers an area of 100 x 250 feet, and it may properly be called 13 stories high.

There are about 6,000 lights wired for, and one of the peculiar features is, that as many as 1,000 are small candelabra lamps of 8 c. p. each, mounted, as a rule, in specially designed fixtures which blend admirably with the various architectural features.

The electric fixtures were all furnished by the Archer & Pancoast Manufacturing Co., of New York, while the contract for the general installation work was carried out by the Edison Electric Illuminating Co., of New York, the actual work of wiring being done by the Eastern District of the General Electric Co.

The building is wired throughout on the system of the Interior Conduit and Insulation Company, and several important novelties and details have been worked out for this particular installation. Among these are the General Electric switches placed flush with the wall, and the new system of switch cut-outs recently perfected by Mr. Herrick for the General Co., which was described in our issue of March 22. The marble-back distributing boards built on this principle, that are used throughout the hotel, are models of excellence, and mark a great advance over the old method of employing separate cut-outs grouped together.

The generating plant, one-half of which is shown in our engraving, Fig. 1, consists of four pairs of 50 K. W. multipolar dynamos, each pair of dynamos being connected to a "Straight Line" engine. This engine has the peculiar advantage, that "outboard bearings" are not required for the dynamos for the reason that the engine governor is placed in the crank disc instead of in the fly-wheel as is the usual practice. The engines run at 220 revolutions per minute and are rated at 150 h. p. each.

The dynamos are of the external yoke type with Gramme-wound armatures, the commutator acting as a part of the winding. These excellent machines were built by the General Electric Company.

The almost noiseless running of these direct-connected generators cannot fail to impress the observer with the great advantages of direct-connected over belt-driven dynamos, especially so when it is considered that this direct-connected plant occupies only about one-quarter, or even less, space, than required for a belted plant of like capacity.

One of the novel features of this plant is the main controlling switchboard shown in Fig. 2, which is noteworthy on account of the small space which it occupies, together with its general finish and convenience for operating. The switchboard differs from the general type of such boards, in that the electrical apparatus is not spread out over an extended wall space, making it necessary for the operator to walk about to see his apparatus and to do his controlling. In the present instance, as will be noted, the dynamo regulating apparatus for the eight dynamos is all placed in the centre panel, which is only 5 feet wide. This apparatus consists of eight special "double-feed" dynamo switches; eight dynamo regulators; eight Weston astatic amperemeters; four Weston voltmeters, and two special dynamo galvanometer switches for "throwing-in" dynamos. On both sides of the centre panel, are panels containing, 12 feeder switches with safety catches, together with four double-feed dynamo switches, and one main "change-over" switch for a capacity of 1,500 amperes. This switch is of new design, which permits a three-wire system to be run as a two-wire system with a very simple and symmetrical arrangement of blades and clips.

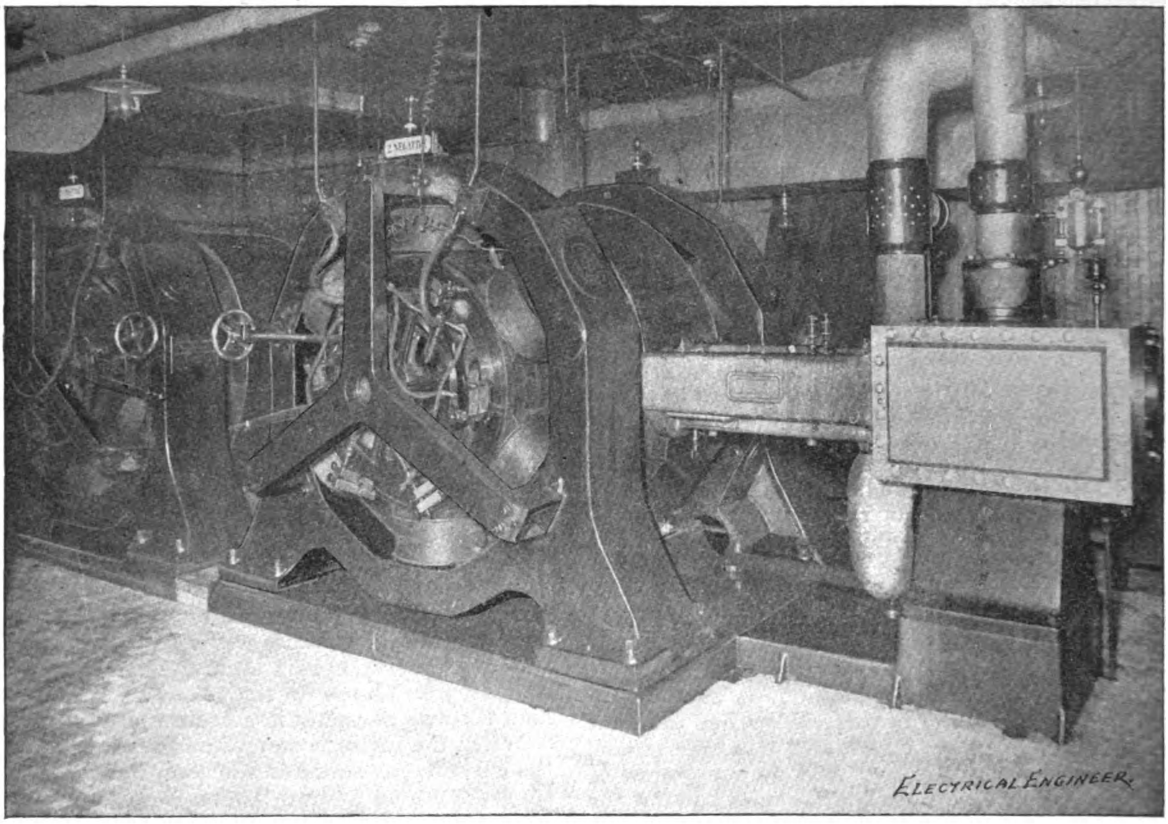


FIG. 1.—DIRECT CONNECTED DYNAMO PLANT, HOTEL WALDORF, NEW YORK.

There are in all sixteen double-feed dynamo switches for the positive, negative and neutral conductors from each dynamo. Each dynamo switch is fitted with safety catches, and the "double-feed" feature permits any dynamo to supply either one or both, of two bus systems. One bus system is called the "private lighting," which consists mostly of private room lighting, and the other bus system is called the "public lighting," which consists mostly of hallway lighting, etc.,—one side of the board being devoted to the private, and the other to the public lighting. The "change-over" switches are so connected, that either system, or both systems, can be operated on the two-wire or three-wire systems. The width of the switchboard over all is only 12 feet.

In order that the operating of the board shall be as simple as possible the practice has been followed of having everything clearly designated with neat, enameled labels. In fact, all the necessary instructions for operating the board can be found printed on the labels, so that the plant can be run by a novice with scarcely any instruction whatever. No combustible material has been used in the construction of the board, and the cable in the rear of the board is neatly wrapped from beginning to end with asbestos cord. The framework of the board is of iron, with Tennessee marble slabs placed on its front and sides.

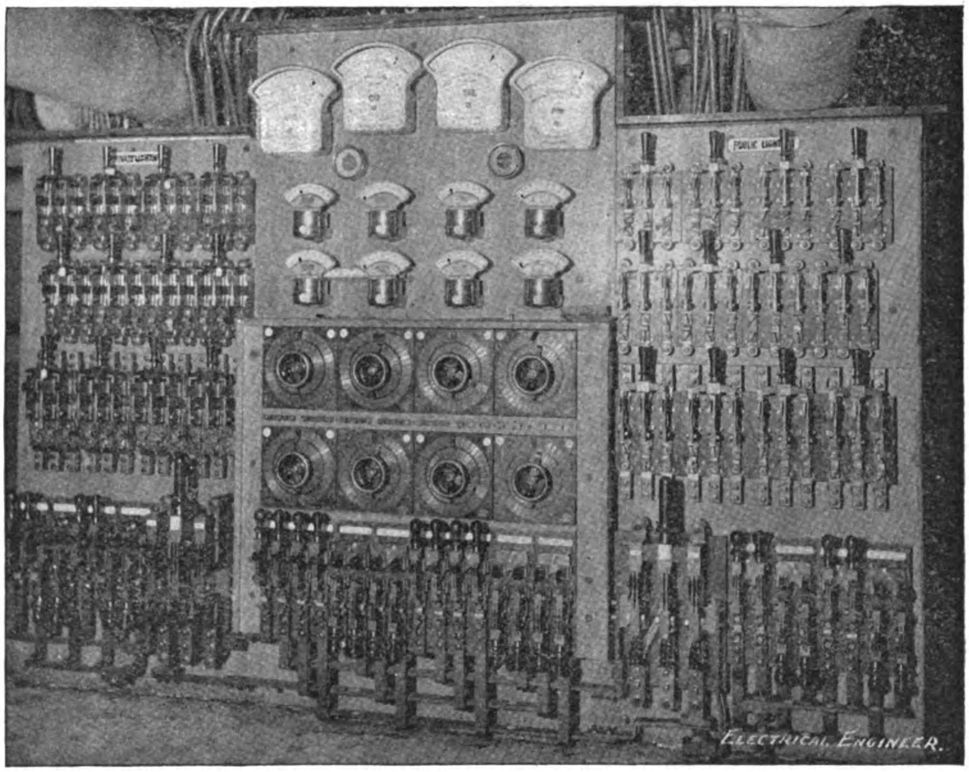


Fig. 2.—Main Switchboard, Hotel Waldorf Electric Lighting Plant.

The board was designed by Mr. John Van Vleck, chief electrician and consulting engineer, and was erected under the superintendence of Mr. Henry Stephenson installation superintendent, and Mr. William Donshea, operating electrician of the Edison Electric Illuminating Company of New York. All of the switches used on this board were designed by Mr. Van Vleck, whose constant aim seems to be to get the most efficient apparatus in the smallest possible space. The dynamo switches were built by the General Incandescent Arc Lamp Company; the feeder switches by the Interior Conduit & Insulation Company, and the change-over switches by the General Electric Company. The ampere and voltmeters were furnished by the Weston Electrical Instrument Company, of Newark, N. J.

DIELECTRIC HYSTERESIS.

The question as to whether there is a true hysteresis in the case of dielectrics has received considerable attention lately, and Steinmetz, Arno, Hess and Janet have published the results of extensive researches on this subject. A note by M. Charles Borel in a recent number of the *Comptes Rendus* has some bearing on this point. He suspends a disc of paraffined paper by its centre in front of a plate which is charged, by means of a rotating commutator, alternately positively and negatively. The duration of the charge was 0.006 second, and between charges of opposite sign it was put to earth for an equal interval. When a glass rod is placed on one side of the disc, so that the plane of the disc and the axis of the rod are parallel to the lines of force of the field, and the end of the rod nearest the charged plate is slightly inclined towards the disc, the latter is rotated. This rotation can be explained by the mutual action of the residual charges in the disc and glass rod when the charged plate is earthed. Different specimens of glass produced very different results on the suspended disc, some having no effect whatever. The replacement of the disc of paraffined paper by one of mica had little effect, while discs of pure paraffin or ebonite showed only a feeble effect. It was found that rods formed of conductors or of good insulators, such as ebonite and shellac, produced a feeble rotation in the opposite direction to that produced by most dielectrics. If the rotation is really due to the residual electrification of the disc or rod this rotation in the inverse direction may be expected whenever the rod has no residual electrification. The effects of crystals held in different directions was tried, and it was found that in general, the deflection varied with the direction of the crystal, which was normal to the charging plate.

Dr. F. A. C. Perrine. It is announced that this well-known engineer, who has lately been appointed to the chair of electrical engineering at Leland Stanford, Jr., University, will marry at Trenton, N. J., on June 28, Margaret Joanna, the daughter of Mr. and Mrs. Ferdinand W. Roebling. Dr. Perrine was at one time in charge of the Roebling insulated wire department.

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World's Fair Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
Western Editor and Manager, L. W. COLLINS, 942 Monadnock Building, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 501 Girard Building, }

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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VOL. XV. NEW YORK, JUNE 21, 1893. No. 268.

ELECTRICITY ON THE CANALS.

THE success which the trolley has scored in the electric railway field has unquestionably impressed upon the mind of the public the practicability of this method of distributing and applying power in connection with other means of transportation. It was indeed some time ago suggested that canal boats might be propelled by means of a system resembling in its general outline the railway trolley system, but up to within a few weeks nothing serious was done in the matter. It is therefore extremely gratifying to know that the problem is now being definitely taken up in New York state, and that no less an influential advocate than Gov. Flower himself has undertaken to champion the cause of the trolley canal boat.

At the last session of the legislature Gov. Flower suggested the appropriation of $10,000, to defray the expenses of experiments looking towards the realization of this scheme, and the superintendent of canals, Mr. Hannan, is now actually prepared to receive suggestions, plans, etc., for the carrying out of the experiments. The problem here confronting the electrical engineer is to furnish power in units averaging from 25 to 100 h. p. upon a line over 300 miles in length. While a number of purely mechanical systems have been proposed, we believe that any one who has at all made a study of the transmission of power will concede that, to cover a line of the length indicated, electricity alone can be employed with economy. Gov. Flower gives expression to his belief that the trolley system could be applied to the canal at an expense not exceeding $1,000,000, which would provide for 12 power houses 30 miles apart. We are not informed as to the details upon which this calculation is based but it would seem that, in view of the present prices of construction, the amount named would hardly suffice to equip a canal in the most approved manner with the most modern power-house construction and overhead work; for it goes without saying, that in an engineering work of such importance provision must be made against interruption of traffic. For the same reason we are not prepared to fully accept the low figures given by the Governor for the cost of operating canal boats by the trolley system—namely 60 cents per day per boat. These are matters, however, which will be easily determined when the experiments now about to be begun shall have been made. The project is certainly worthy of all the time and care which can be bestowed upon it by our state authorities, and it is to be hoped that electrical engineers will actively participate in an undertaking which may result in a most important advance for the entire industry.

EWING'S MAGNETIC CURVE TRACER.

THE well established laws and rules for the construction of dynamo electric machinery at the present time permit such apparatus to be calculated with a high degree of accuracy. All such calculations, of course, are based upon the assumption that the iron employed is of a given magnetic character, but, unfortunately the iron furnished to the manufacturer is apt to vary from that assumed in the calculation, and much annoyance and expense frequently results therefrom. An instrument, therefore, to enable the manufacturer to readily test the quality of his iron must be considered to be of the highest practical, economical value. Eickemeyer's magnetic bridge, brought out some time ago, was a great step forward in this direction, and it is now supplemented by the admirable "magnetic curve tracer" of Prof. Ewing, which we illustrate on another page. The graphic representation of the magnetic properties of the iron submitted to the test afforded by Prof. Ewing's instrument will now serve a purpose analogous to that of the steam engine indicator diagram, and it is to be hoped with equally valuable results.

AT THE WORLD'S FAIR.

THE World's Fair has been a long time assuming shape, but it will have been seen from the reports in the daily papers that it is now well-nigh completed, and very beautiful to look upon. As to Electricity Building, Mr. Muldaur, whose articles have been so full and interesting, sends an account this week which shows that the work there is in the final stages. Even were this not so, the visitor will find enough to repay him for all his trouble and expense. Many electricians will doubtless postpone their trip to Chicago until the Congress at the end of August, when beyond question all the apparatus will be installed and all the exhibits be finished and in working order. It will have been gathered from Mr. Muldaur's articles that a large number of features highly interesting to electrical engineers lie outside Electricity Building, and that hardly any part, be it mining, manufactures, transportation, or machinery, or governmental is without special electrical attractions.

WORLD'S FAIR DEPARTMENT.

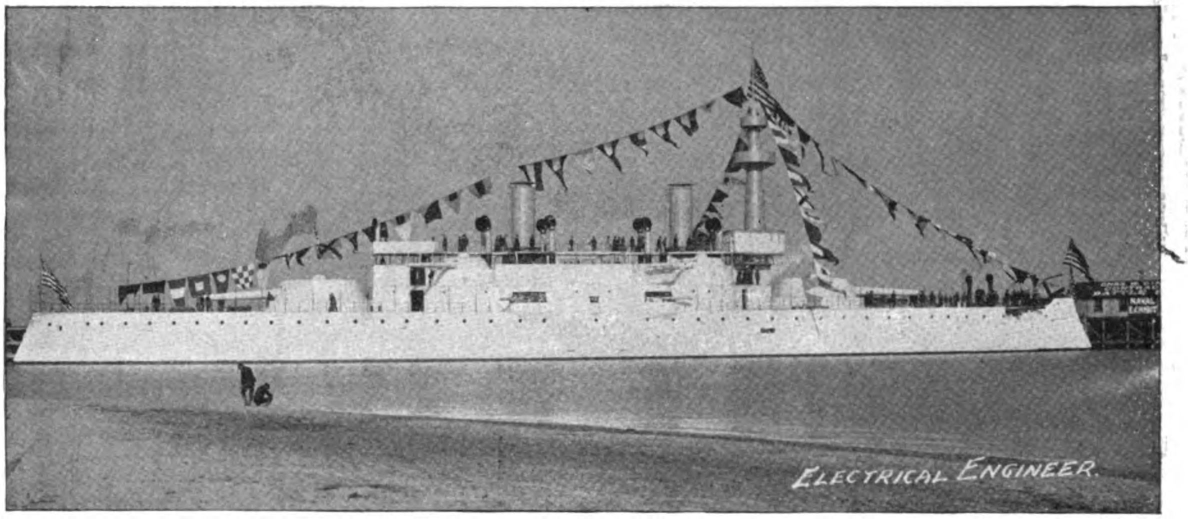

FIG. 1.—THE BATTLE SHIP "ILLINOIS," U. S. NAVAL EXHIBIT, WORLD'S FAIR, CHICAGO.

ELECTRICITY ON THE BATTLE SHIP "ILLINOIS."

THE result of the earnest efforts of naval engineers during the last few years not only to improve the character and methods of installation of electrical apparatus on war vessels, but also to adopt definite standards for all such devices with a view to repairs and emergencies, is most interestingly shown on board the model battle ship "Illinois," at the World's Fair.

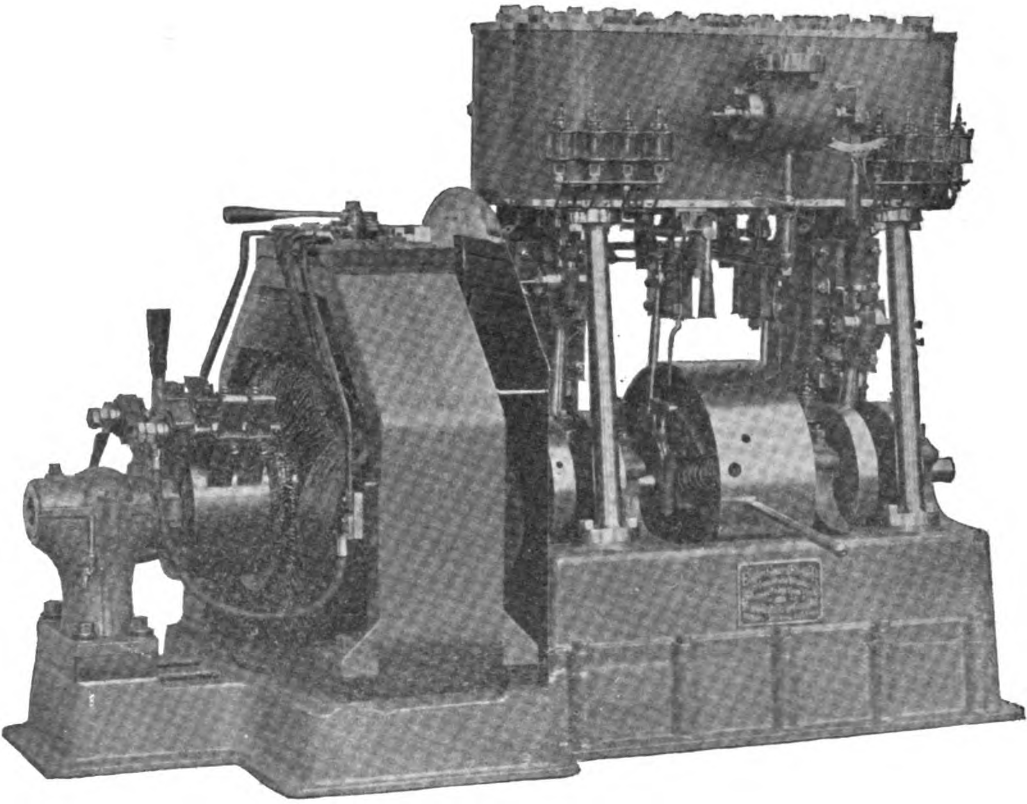

FIG. 2.—TYPICAL SHIP PLANT ON BOARD BATTLE SHIP "ILLINOIS."

The ship, which is illustrated in our engraving, Fig. 1, is built in the lake at what would be the foot of 59th street—were it cut through the park—on piles and heavy timbers. The hull is of brick covered with cement up to the main deck while the superstructure, redoubts and barbettes are of wood covered with cement held in place by metal lath, and nothing is shown below the berth deck. In other respects, however, the vessel is built and equipped like the real thing and gives an excellent idea of the naval architecture of the present day. Besides being an exhibit itself, it contains the Navy Department display, so that some departure from the ordinary plans between decks has necessarily been made, but in all essential respects the "Illinois" is a faithful copy, so far as appearance above the waterline is concerned, of our battle ships.

The electrical installation consists of two generating sets, about 400 incandescent lamps, two search lights, signaling apparatus, two stationary ventilating fans and several portable fans, with switchboard, rheostats, etc., and also some special apparatus, designed for this particular plant and not forming part of the actual exhibit, but which is highly interesting in itself. The generators are four pole, 80-volt, 200 ampere iron-clad machines made by the General Electric Company, direct-connected to double cylinder, vertical engines running at 400 revolutions and designed to bear without injury the throwing off of the entire load by simply breaking the circuit. These engines are built for an initial pressure of 80 pounds condensing, but are capable of being worked at any load up to the capacity of the dynamos at 60 pounds atmospheric exhaust to 100 pounds condensing, and govern automatically within close limits. One of these marine sets is shown in Fig. 2.

The arrangement of the circuits from the dynamos to the lamps, fans, etc., is shown in the diagram, Fig. 3. The two-wire system is used throughout. The main deck battle mains run the whole length of the superstructure deck and supply lights for the guns and passages on the main deck, while the mains for the battery, signal and running light section furnish current for the lights on that deck and on the bridge. The wire is what is known as the "E. M. F.," made by the United States Wire and Cable Company, and is put to severe tests before being used. One test is to heat it in an oven to a temperature of 212 degrees F. and then to immerse it in salt water. No conductor has an area of cross-section less than 1,000 circular mils per ampere at full load reckoned at the rate of .05 ampere per c. p. Two-groove, soft pine molding incloses the wires and is provided with a backing strip which is omitted, however, on smooth metal surfaces and where junction boxes are not used.

The switchboard consists of a switchboard proper and two instrument boards, all made of slate one inch thick. Provision has been made for six incandescent, two search light and two motor circuits. The general design is such that any number of dynamos may run singly on any circuit or combination of circuits in parallel. The bus bars are at the back of the board, two common-negative and as many double positive bars as there are dynamos; in this case two, and a double-pole switch for each generator, connect the terminals of the equalizing wire and the positive bus bars with a common equalizer and a common positive bar. The negative dynamo terminal is connected by a single-pole switch with the negative bar and the positive terminal by a double-throw shifting-switch connected with any positive bar. The circuit switches are designed to carry 100 amperes. The instrument boards are fitted with a ground detector, two voltmeters and a multipolar switch for each instrument having as many points as there are double-positive bars on the switchboard, and an equal number of ammeters.

This is the lighting plant as seen by the public, and as it would appear on a real man-of-war, but the exigencies of the case on board a ship of brick and plaster supported on piles brought up new problems which have been solved in a manner perhaps unique. In the first place, as the ship has no existence below the water line no boilers can be had on board. The distance from Machinery Hall is too great to run steam mains; so it was decided to take current from the Intramural Railway close at hand, operating on a 550 volt circuit, and transform it to 80 volts on board. There is therefore provided a small room, having no place on a real

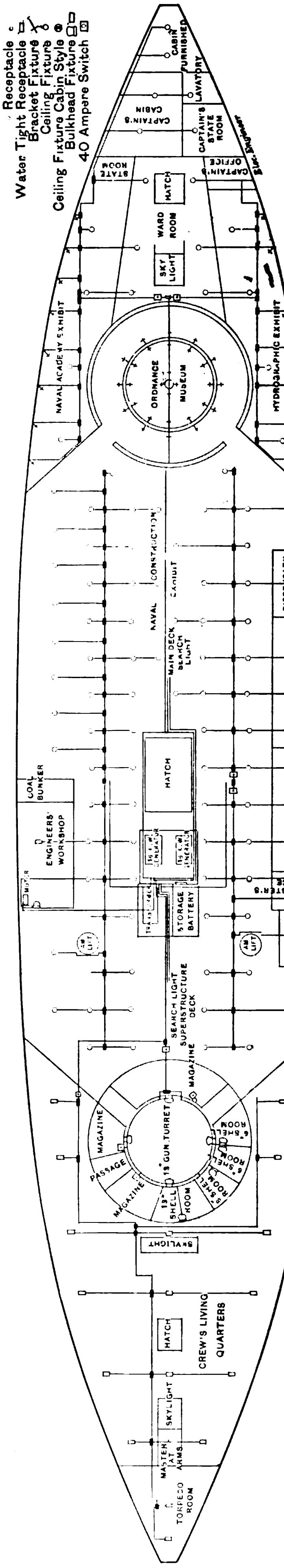

FIG. 3.—BATTLE SHIP "ILLINOIS."—PLAN SHOWING METHOD OF WIRING FOR LIGHTING AND POWER SERVICE.

vessel (and in fact not supposed to be seen on this one) in which is a 50 h. p. multipolar motor driven by the 550 volt railway circuit and directly connected with a 32 kilowatt multipolar dynamo generating 400 amperes at 80 volts. One hundred cells of accumulators in two series of 50 each are placed in multiple with the generator to compensate for the variable nature of the current and also serve as a current source after the railway stops running. To give an air of reality, however, to the marine sets supposed to be furnishing current to the ship, these generators are run as motors and the engines, from which the pistons have been removed, appear to be doing great work and to run very smoothly and noiselessly withal.

Besides the regular lights of the vessel there are, as before stated, two search lights placed forward and aft on the bridge and an Ardois signal outfit by means of which 60 different combinations can be made with five double lanterns, each containing a red and a white lamp, suspended 10 feet apart by means of two wire jack-stays with connecting cross-arms. The cable carrying the conductors contains a wire for each lamp with a common return. The projector and its controlling board, designed by Mr. E. R. Knowles, electrician of the Schuyler Electric Company, have already been fully described in THE ELECTRICAL ENGINEER.[1]

The portable ventilating set, consists of a Sturtevant fan coupled to a ½ h. p. General Electric motor.

Among the other interesting devices forming part of this exhibit may be mentioned electric speed indicators and telegraphs, rudder indicators, telethermometers and barometers, and a Thomson vertical force instrument for correcting the deviation of the compass for the "heeling error." Naturally the speed and rudder indicators are not brought into play to any great extent on board the "Illinois." The whole exhibit, without doubt, is one of the most interesting at the Fair.

THE MOVING SIDEWALK AT THE WORLD'S FAIR.

IN the last issue I gave a description, with detailed plans, of the moving sidewalk recently put in operation at the World's Fair, and I am enabled this week to present our readers with a view showing the sidewalk as it now appears completed. It will be remembered that the sidewalk consists of two continuously moving platforms, one progressing at the rate of three miles an hour, and another at six miles an hour. The slow moving platforms are carried upon railway motor trucks, while the fast moving platforms rest upon the periphery of the wheels of the slower one. The difference in speed between the two platforms is such that one can readily step from one to the other without fear of accident. The sidewalk rests on the pier running out into the lake from the Casino building.

THE MOVING SIDEWALK AT THE WORLD'S FAIR.

PELTON WATER WHEELS AT THE COLUMBIAN EXPOSITION.

THE accompanying cuts illustrate two Pelton wheels and show the latest design and improvement in high pressure wheels and governing apparatus, particularly adapted for electrical service. The wheel shown in Fig. 1 is 32 inches in diameter and is supplied with a single nozzle. It is coupled direct to the armature shaft of an Edison dynamo and used in connection with the mining exhibit of the General Electric Company. The wheel is run by a pump which delivers water with a pressure of 280 lbs., equal to a vertical head of 650 feet. The speed due to this head is 750 revolutions per minute. The regulator connected to this wheel is of the friction type and is only intended to be used in connection with small nozzles as in the present case.

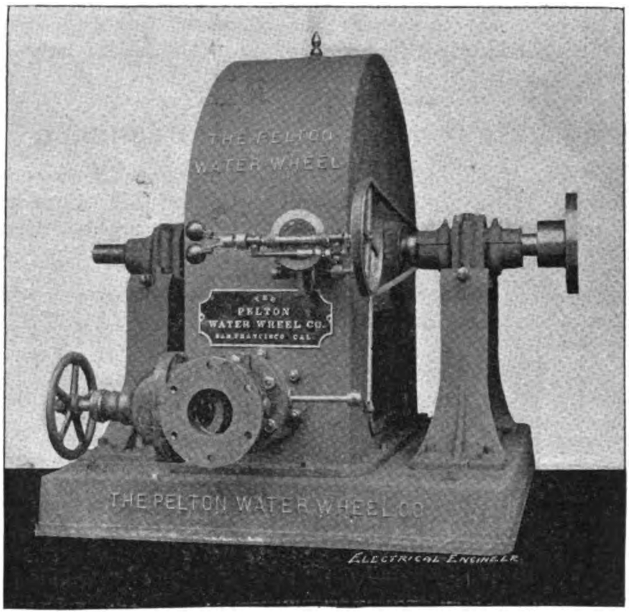
THE PELTON WATER WHEEL
THE PELTON WATER WHEEL CO. SAN FRANCISCO CAL.
THE PELTON WATER WHEEL CO
ELECTRICAL ENGINEER

FIG. 1.—PELTON WHEEL WITH FRICTION REGULATOR.

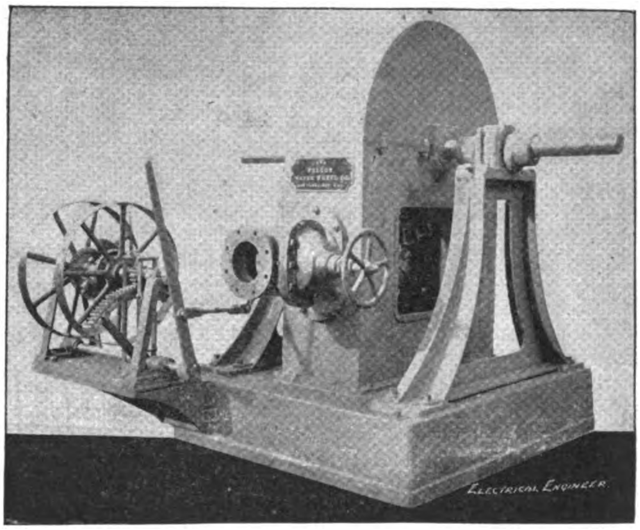

FIG. 2.—PELTON WHEEL FOR LOW PRESSURE SERVICE.

Fig. 2 shows a wheel in connection with the Westinghouse exhibit, 34 inches in diameter and supplied with double nozzle. The reason for the double nozzle on this wheel is that the pressure is not as high as in the former case, and more power is required. The wheel is running under 200 lbs. pressure, equal to a vertical head of 462 feet. The pressure is obtained from a pump as in the former case. The wheel makes 600 revolutions per minute and is coupled direct to the armature shaft of a Westinghouse generator.

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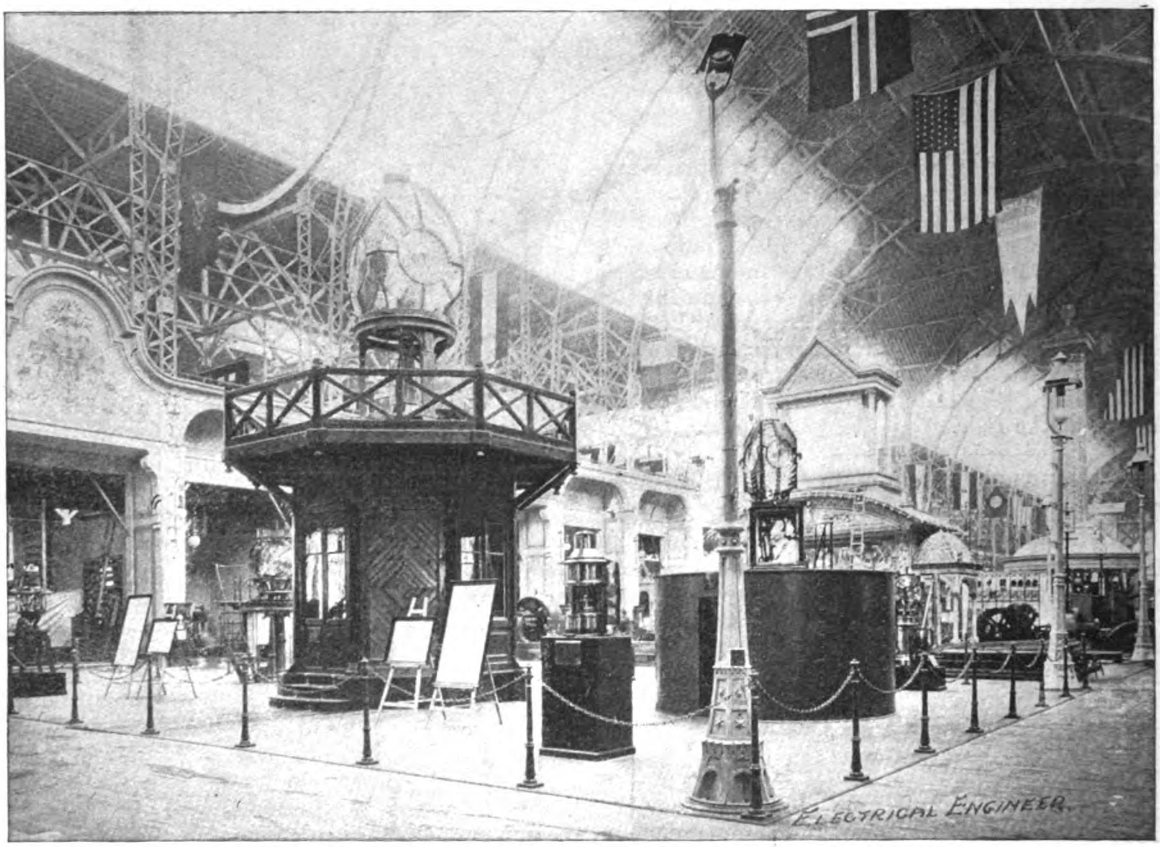
[1] See THE ELECTRICAL ENGINEER, Aug. 24, 1892.

This wheel is regulated by a differential governor which has just lately been perfected by the Pelton Company. It will be observed that each wheel case has plate glass inserted in the sides so that the action of the water may be clearly seen.

PROGRESS IN THE ELECTRICITY BUILDING

THE last week has seen a marked advance in the condition of things in "Department J;" in fact, there are now parts of the building from which the sightseer can get a view unobstructed by scaffolding and unmarred by piles of boxes and debris. Still, much remains to be done and the conclusion of the whole matter cannot be expected for a week or two at least.



VIEW IN ELECTRICITY BUILDING, WORLD'S FAIR, LOOKING SOUTH.

Considering the very small exhibit made by England it seems singular that she is now the most backward of all. The General Electric Company, Limited, of London and Manchester, have indeed made a very creditable display, already described and illustrated in THE ELECTRICAL ENGINEER of May 31, and have had it ready for inspection for some time. There is also an English exhibit of speaking tubes intended, and advertised, to do away with the telephone for short distances, and with these two exceptions the English space, up to June 14, has been absolutely bare. Now, that the other exhibits are reduced to something very much like order, suddenly enter the boxes, crates and bales containing the apparatus of the English Postal exhibit under the supervision of Mr. W. H. Preece, who is expected later on. These stand on the ground floor looking anything but ornamental and when bye-and-bye the workmen have opened them and disposed their contents on the counters provided for them, the British electrical exhibit will be complete.

Directly opposite is the beautiful "golden pavilion" of of the Westinghouse Company, and across the building the German exhibitors have erected their imposing booths and filled them with the splendid results of German study, experience and genius. France occupies a conspicuous central space at the north end, next to the most northern Westinghouse display and also the entire northwest bay and makes an attractive exhibit. Truly, England could have done better.

The illustration on this page shows part of the building as it appears to-day looking south on the ground floor. In the foreground is seen the light house exhibit of Barbier & Co., French section, that added so much to the brilliance of the scene during the opening ceremonies two weeks ago. In the centre of this space stands a low frame lighthouse surmounted by a four-lens lantern of a size greater than that known as first-class. Each lens is one metre in diameter and the light can be seen at a distance of 60 miles. It is revolved by clockwork, and is arranged for either electric light or oil, as desired. In the present case the latter is employed. Two lights of this class are now being erected for the Government of China. Near by is a second-class light with two lenses so arranged that it may be revolved by clockwork or an electric motor. For actual seacoast work where the rate of revolution designates the particular point where the lighthouse stands, and where any variation in speed would throw vessels out of their bearings, clockwork is used in preference to a motor for obvious reasons, but there are many occasions where the latter may be advantageously employed.

On the iron turret just beyond, is a fourth-class light with four lenses, 30 centimetres in diameter, employing electricity for illumination. A fifth-class light with one lens and a fourth-class with two lenses, both revolved by clockwork at one revolution every five and ten seconds, respectively, occupy conspicuous positions on the left, while ships lanterns, pier lights and buoy signals also form part of the display.

The most striking piece of work in the exhibit, however, is the enormous lens standing on a pedestal by itself directly opposite the central north entrance of the building. This is 2.2 metres in diameter, and is, I believe, the largest in the world. It was made for the Exhibition in Paris in 1889, where it took the gold medal, and was later shown at the Moscow exposition last year.

The next thing to catch the eye after passing the lighthouses is the golden pavilion just erected by the Westinghouse Company in the centre of one of their newly acquired spaces. This was referred to in our article on the opening of the building, and is not yet complete, so no further description is yet in order. The company are showing in this space model power-transmitting and receiving stations separated by the pavilion and supposed to be twenty miles or more apart. In the first is a 400 h. p. Tesla motor run by current from the large Westinghouse direct-coupled 1,200 h. p. generator in Machinery Hall. This motor drives a 500 h. p. two-phase generator direct-coupled to a 40 h. p. Pelton water-wheel. This is, of course, merely to show the method of utilizing water-power. The generator is not run at anything like its full load. The current is led to the receiving station at the opposite end of the space to a 500 h. p. revolving transformer whose motor part operates a 40 h. p. pump and a 40-light alternating current arc generator. As a transformer this machine delivers current at 500 volts to two 30 h. p. motors mounted on a Donner & Dutton truck and also to an Ingersoll-Sargent air pump. Other revolving transformers of smaller sizes are also shown, and standard Westinghouse switchboards for both the receiving and transmitting station complete this part of the display.

Another interesting Westinghouse exhibit, consisting principally of railway generators and motors, the latter mounted on trucks, and complete cars, is being completed at the other end of the building, and will, together with that just touched upon and the rest of the company's work in this department, be treated in detail at the proper time.

The Bell Telephone temple has undergone alteration. The exhibit has become so popular that it was found necessary to provide more room for handling the crowd, and the cloister has been widened by decreasing the size of the inner court. The work was done with an expedition that was positively startling when one has become accustomed to Exposition methods and shows very clearly that it is quite possible to push matters to completion even in Chicago. This might be accepted with advantage as an object lesson by some of the other exhibitors.

THE RELIANCE GAUGE EXHIBIT IN ELECTRICITY BUILDING.

The Reliance Gauge Company of Cleveland, Ohio have, as noted last week, one of the most attractive exhibits on the second floor of the Electricity Building, showing a full assortment of their celebrated "Reliance" safety alarm water columns for steam boilers varying in size from 1 to 1,000 h. p. The exhibit is very handsomely and tastefully arranged. The floor is covered with Brussels carpet and the stands with plush, while olive plush draperies form a background against which the highly polished aluminum, brass and nickel-plated columns stand out in bold relief, giving the exhibit a very artistic appearance.

Whenever the steam space of a boiler becomes "crowded" with water, wet steam and an over-taxed boiler are the result, while unnecessary fuel is used to heat the water. With the ordinary water column it makes no difference how high or how low the water gets in the boiler. If the fireman is negligent or careless there is no check on him, and if a water glass becomes stopped or the feeding apparatus fails to work without warning, there is apt to be trouble. The Reliance safety columns take the place of the ordinary water columns and resemble them in every external detail, having both the gauge cocks and the water gauges. On the inside, however, there are two floats and a valve which do not in any way interfere with the gauge cocks or water gauges which are entirely separate and independent. When the water starts to rise above the third gauge the high-water float raises the valve lever, sounds the alarm for high water at the third guage, compels the fireman to keep the water down where it should be all the time and also informs his superiors of his carelessness. It is impossible for him to get $\frac{1}{16}$ of an inch more water in the

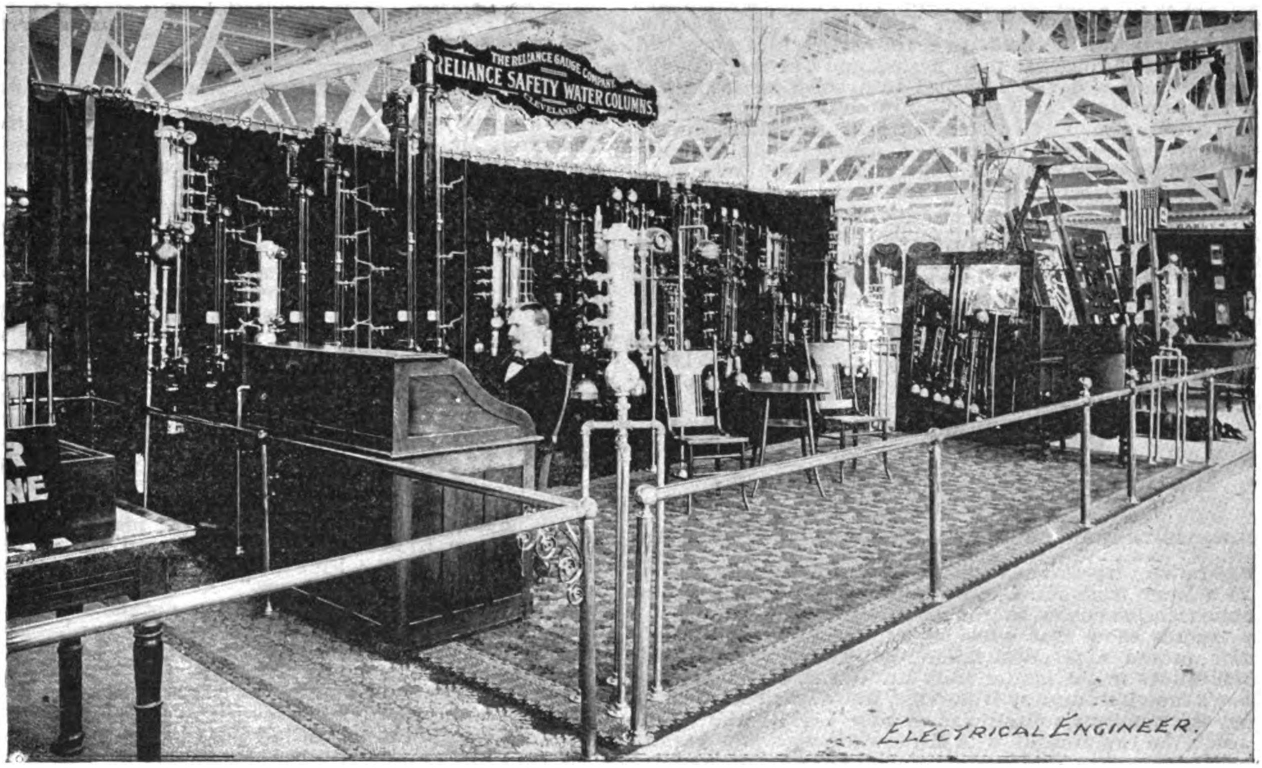


Exhibit of the Reliance Gauge Co. in Electricity Building.

boiler than he should have at any time without being instantly reported. This insures the good dry steam which to an electrical or power plant is positively invaluable. When the water falls to the first gauge cock the float falls by gravity and sounds the alarm for low water, calling the attention of the attendant with whom, of course, to be forewarned is to be forearmed. Though there are 25,000 of these columns working in all parts of the country every day, there has never been reported a single instance where a boiler so equipped has been burned or exploded.

Another feature of the Reliance column is its trap sediment chamber. With the ordinary water column, whenever any mud or foreign matter in the water comes in through the feed pipe, it circulates around through the column, soiling and often even stopping the water glass and then falls back into the feed pipe only to come back again the next time the gauge cock is tried. The Reliance column however feeds at the side, and every particile of mud which comes in the column is trapped down into the sediment chamber, after which is can not get back into the column. This leaves the water free and clear to circulate through the column and keeps the glass like new. The value of this cleanliness cannot be overestimated; in fact, according to the president of the Hartford Steam Boiler Insurance Co., this feature alone is worth the price of the column. As a fuel saving device this column is a decided success for this reason. Every inch of water above the third gauge is a surplus and wholly unnecessary, but when once in the boiler it must be heated with the necessary water, requiring a surplus of fuel and a consequent unnecessary waste. Wet steam also causes an unequal expansion and contraction due to the great variation of the water as it rises and falls indiscriminately with no regularity. The Reliance column on the contrary never allows the water to get above the third gauge and consequently no surplus has to be heated, and a saving in fuel is the result. Such a device attached to a boiler means in fact simply this: dry steam, no leaky tubes caused by unequal expansion and contraction, and economy in fuel. In addition every act of carelessness on the part of employees is instantly reported, and they are thus compelled to watch the boiler at all times. Indeed these safety columns are firemen who never leave the boiler room, and watchmen who never sleep.

The exhibit shown in the accompanying illustration, is in charge of Mr. Geo. B. Clark. All readers of THE ELECTRICAL ENGINEER are cordially invited to step in and see this exhibit, and, I might add, there are several comfortable chairs to rest in while looking it over so that I see no reason for anybody leaving the space with a tired feeling. The boilers in Machinery Hall are also equipped with their columns but the aluminum models cut open to show the working parts give one a better idea of its simplicity and value as a safe guard.

LETTERS TO THE EDITOR.

AUTOMATIC TRANSMISSION ON LONG SUBMARINE CABLES.

I WAS rather surprised and amused on reading in your issue of May 24 a letter from Mr. Charles G. Burke, on the subject of automatic transmission on long submarine cables.

My records show that while under our tests Mr. Burke's invention proved a practical failure, but I send you herewith communications in the matter from Mr. Thomas J. Wilmot, the company's superintendent at Waterville, Ireland, and Mr. Charles Cuttriss, the company's electrician at New York, under whose supervision the experiments with Mr. Burke's apparatus were at different times made. Their statements are conclusive.

The Commercial Cable Company was never impressed with the value of Mr. Burke's instrument or the results achieved with it; and as far as negotiations for the control of his invention are concerned, I may say that it is the usual course of the Company, in consideration of permitting experiments and the possibility of an invention proving of value, to secure an option on the invention. Mr. Burke's case was no exception.

GEO. G. WARD,
Vice-President and General Manager,
COMMERCIAL CABLE CO.

NEW YORK CITY, June 16, 1893.

IN reply to Mr. Charles G. Burke I beg to submit the following facts. During the months of February and March, 1886, it was my duty as superintendent here, to assist him in some experiments with a transmitting device which he had invented. These experiments were conducted on the Waterville-Canso cable. The results were not the success Mr. Burke claims for them and I was obliged to report unfavorably, as the number of words transmitted by his apparatus per minute was less than half of what we were doing by hand signaling.

It has never been asserted that I was the first to *demonstrate* the practicability of working long cables successfully by means of an automatic transmitter. This pioneer work was accomplished by Messrs. Thomson and Jenkin about ten years before Mr. Burke entered the field and it might therefore be well to definitely state my claim. I claim I was the first to design and apply to the working of long submarine cables an automatic transmitter which achieved a commercial success by utilizing to the greatest degree the carrying capacity of a cable and by performing the work better than it ever had been or could be done by hand.

Mr. Burke's statement that during his stay at Waterville he used the Wheatstone transmitter to ascertain facts, etc., is not strictly accurate. It was I who suggested and carried out this experiment, the object in view being to determine the maximum number of current reversals the particular cable would carry legibly, and this information was placed at Mr. Burke's disposal.

I will add that work was commenced on my instrument before I ever heard of Mr. Burke. This assertion is supported by my official correspondence, and at once disposes of the theory that the substitution of punched paper for a key board such as he uses is a natural sequence.

In conclusion and to more thoroughly refute Mr. Burke's claim I will say that my instrument was in successful operation as early as April 1886, although the improved patented form did not appear until later.

THOMAS J. WILMOT.

WATERVILLE, IRELAND, June 6, 1893.

REGARDING Mr. Burke's letter in THE ELECTRICAL ENGINEER of the 24th ultimo. His statements are entirely misleading, and are evidently intended for the purpose of making capital or gaining notoriety by using my name while misrepresenting facts concerning certain experiments which I conducted for him during the latter part of 1885. These experiments were made on the New York-Canso (Nova Scotia) section of the Commercial Cable Company's system, and instead of being a pronounced success, as claimed by him, they were of an exactly opposite character. The speed attained by his instrument never even approached the speed obtained daily by ordinary hand sending, and in a report which I have before me I distinctly pointed out the utter failure of the instrument to accomplish what is claimed for it.

Mr. Burke, however, was so elated in getting some slow signals over the cable that nothing short of a trial over one of the long cables would convince him of the impracticability of his instrument. He was so persistent in his endeavor that at last the Company granted him the privilege of making further trials. This was seven and a half years ago, and the fact that his instrument has never been adopted by the Commercial or any other Atlantic cable company, is in itself sufficient testimony of the negative value of his invention or the success of his experiments.

Mr. Burke's remarks on dogmatic arguments, etc., cannot refer to the Commercial Cable Company, as every invention tested by it and found of worth has been adopted. In proof of which I will venture that no cables throughout the world are operated at a speed equal to that constantly maintained over the Commercial Cable Company's system.

The foregoing facts cannot be controverted, as they are a matter of record.

CHARLES CUTTRISS.

NEW YORK, June 15, 1893.

THE TELEPHONIC NEWSPAPER SERVICE AT BUDA-PEST.

IN a recent letter to the Boston *Daily Advertiser*, dated from Buda-Pest, Mr. F. B. Sanborn gives the subjoined interesting account of the manner in which the Puskas telephonic news service is conducted there:

The capital of Hungary, where I am now spending a few days, has distinguished itself among the cities of the globe by establishing a telephonic newspaper, which has now been in existence some months and is extending its plans and scope. The *Oriental Review* of this city of April 30 gives a long account of what this novel enterprise has done and may do, which I am sure will interest my readers. The whole city of 500,000 people—as large as Boston (and, I may add, quite as handsome and better served with street railways), is divided into eight sections for the purposes of this telephonic editor, and each of the sections has one conducting wire. The apparatus in each house occupies a space of about five inches square and has two tubes, so that two members of the family can get the news at once. The whole cost of putting it in is $6, and each subscriber pays a rate of sixty cents a month for the special newspaper service.

The news collector does his work in the night, as elsewhere, and at 9 a. m. he takes his post in the central station and begins to tell his story "in a telegraphic style, summary and precise, avoiding everything superfluous." At the end of five minutes, fearing lest some of his subscribers may not have heard everything, he repeats his budget of news, word for word—mostly concerning home events and news of Hungary. At 10 o'clock he issues another oral edition, this time of foreign news. At 11 o'clock he lets us know that the Hungarian Parliament is in session, and may mention what is being debated. But word may also come of a riot, and by noon the alarmed subscriber may hear that the populace have attacked the police and been fired upon; this, we will say, causes stocks to fall 5 per cent. Immediately the wise subscriber rushes to his own telephone and gives his broker an order to buy. At 2 o'clock the central editor rings furiously and reports a violent debate in Parliament, which leads to a change of the Ministry. At 3 o'clock there is a fire in a building of which the subscriber is part owner—and so it goes on.

"All this news," says my author, "is related in a sonorous voice, easily understood—and, as there is only one wire, the subscriber is not vexed with the hubbub of twenty voices trying to use the same wire at once. Still, it is a little fatiguing to get your news in such slices instead of having it all in your hand at once. So (I continue to quote), at 6 o'clock he can take a rest (that is, the subscriber can), and madame, his wife, comes forward to hear the report of a lecture at the Academy; perhaps the repetition, with all due emphasis of a new poem. At 7 o'clock the young ladies listen to a concert through the *Telephonic Gazette*; they can distinguish wonderfully well the touching pathos of the violoncello, the pearly staccatos of the violin, the sweet melodies of the flute, and the enchanting voice of the prima donna." What could be more delightful and convenient?

All this, I am assured, is daily going on in Buda-Pest. Nay more, "by the aid of a single wire of the State telegraph line, our central station has been connected simultaneously with the telephone stations of Vienna, Gratz, Brunn, and Trieste; and in all those cities the voice of the *Gazette's* editor has been heard—clear, sonorous, and with every shade of intonation."

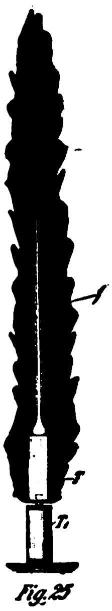
MISCELLANEOUS.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.[1]—IV.

BY NIKOLA TESLA.

I have contrived an experiment which illustrates in an interesting manner the effect of lateral diffusion. If a very long tube is attached to the terminal of a high frequency coil, the luminosity is greatest near the terminal and falls off gradually towards the remote end. This is more marked if the tube is narrow.

A small tube about one-half inch in diameter and twelve inches long, Fig. 25, has one of its ends drawn out into a fine fibre *f* nearly three feet long. The tube is placed in a brass socket T which can be screwed on the terminal T_1 of the induction coil. The discharge passing through the tube first illuminates the bottom of the same, which is of comparatively large section; but through the long glass fibre the discharge cannot pass. But gradually the rarefied gas inside becomes warmed and more conducting and the discharge spreads into the glass fibre. This spreading is so slow, that it may take half a minute or more until the discharge has worked through up to the top of the glass fibre, then presenting the appearance of a strongly luminous thin thread. By adjusting the potential at the terminal the light may be made to travel upwards at any speed. Once, however, the glass fibre is heated, the discharge breaks through its entire length instantly. The interesting point to be noted is that, the higher the frequency of the currents, or in other words, the greater relatively the lateral dissipation, at a slower rate may the light be made to propagate through the fibre. This experiment is best performed with a highly exhausted and freshly made tube. When the tube has been used for some time the experiment often fails. It is possible that the gradual and slow impairment of the vacuum is the cause. This slow propagation of the discharge through a very narrow glass tube corresponds exactly to the propagation of heat through a bar warmed at one end. The quicker the heat is carried away laterally the longer time it will take for the heat to warm the remote end. When the current of a low frequency coil is passed through the fibre from end to end, then the lateral dissipation is small and the discharge instantly breaks through almost without exception.



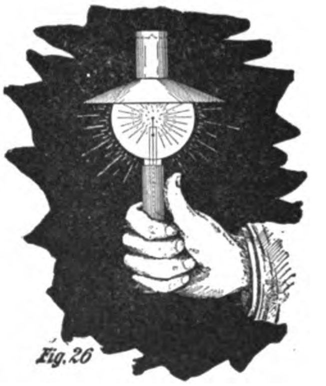
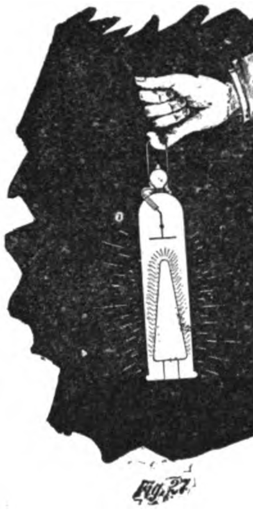


FIG. 25.—ILLUSTRATING LATERAL DIFFUSION.
FIG. 26.—INCANDESCENCE OF A SOLID.

After these experiments and observations which have shown the importance of the discontinuity or atomic structure of the medium and which will serve to explain, in a measure at least, the nature of the four kinds of light effects produceable with these currents, I may now give you an illustration of these effects. For the sake of interest I may do this in a manner which to many of you might be novel. You have seen before that we may now convey the electric vibration to a body by means of a single wire or conductor of any kind. Since the human frame is conducting I may convey the vibration through my body.

First, as in some previous experiments, I connect my body with one of the terminals of a high-tension transformer and take in my hand an exhausted bulb which contains a small carbon button mounted upon a platinum wire leading to the outside of the bulb, and the button is rendered incandescent as soon as the transformer is set to work (Fig. 26). I may place a conducting shade on the bulb which serves to intensify the action, but is not necessary. Nor is it required that the button should be in conducting connection with the hand through a wire leading through the glass, for sufficient energy may be transmitted through the glass itself by inductive action to render the button incandescent.



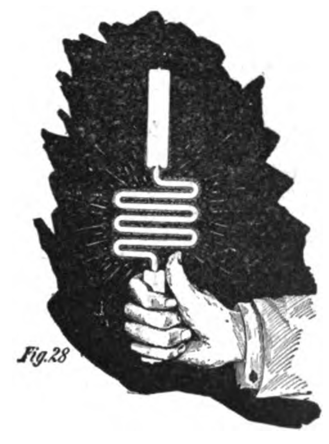
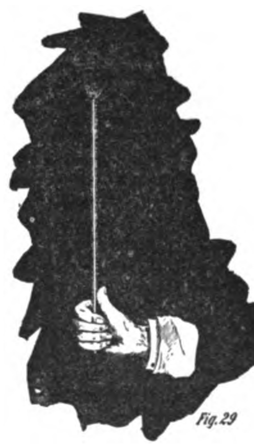


FIG. 27.—PHOSPHORESCENCE.
FIG. 28.—INCANDESCENCE OR PHOSPHORESCENCE OF RAREFIED GAS.

Next I take a highly exhausted bulb containing a strongly phosphorescent body, above which is mounted a small plate of aluminum on a platinum wire leading to the outside, and the currents flowing through my body excite intense phosphorescence in the bulb, Fig. 27. Next again I take in my hand a simple exhausted tube, and in the same manner the gas inside the tube is rendered highly incandescent or phosphorescent, Fig. 28. Finally, I may take in my hand a wire, bare or covered with thick insulation, it is quite immaterial; the electric vibration is so intense as to cover the wire with a luminous film, Fig. 29.

A few words must now be devoted to each of these phenomena. In the first place, I will consider the incandescence of a button or of a solid in general, and dwell upon some facts which apply equally to all these phenomena. It was pointed out before that when a thin conductor, such as a lamp filament, for instance, is connected with one of its ends to the terminal of a transformer of high tension the filament is brought to incandescence partly by a conduction current and partly by bombardment. The shorter and thicker the filament the more important becomes the latter and finally, reducing the filament to a mere button, all the heating must practically be attributed to the bombardment. So in the experiment before shown, the button is rendered incandescent



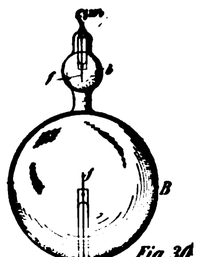


FIG. 29.—LUMINOSITY OF GAS AT ORDINARY PRESSURE, ILLUSTRATING WITH FIGS. 26, 27 AND 28 FOUR KINDS OF LIGHT EFFECTS PRODUCED BY HIGH-FREQUENCY CURRENTS OF HIGH POTENTIAL.

FIG. 30.—SHOWING THE EFFECT OF CONFINING THE GAS AROUND THE ELECTRODE.

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[1] A lecture delivered before the Franklin Institute, at Philadelphia, Feb. 24 1893, and before the National Electric Light Association, at St. Louis, Mo., March 1, 1893.

by the rhythmical impact of freely movable small bodies in the bulb. These bodies may be the molecules of the residual gas, particles of dust or lumps torn from the electrode; whatever they are, it is certain that the heating of the button is essentially connected with the pressure of such freely movable particles, or of atomic matter in general in the bulb. The heating is the more intense the greater the number of impacts per second and the greater the energy of each impact. Yet the button would be heated also if it were connected to a source of a steady potential. In such a case electricity would be carried away from the button by the freely movable carriers or particles flying about and the quantity of electricity thus carried away might be sufficient to bring the button to incandescence by its passage through the latter. But the bombardment could not be of great importance in such case. For this reason it would require a comparatively very great supply of energy to the button to maintain it at incandescence with a steady potential. The higher the frequency of the electric impulses the more economically can the button be maintained at incandescence. One of the chief reasons why this is so, is, I believe, that with impulses of very high frequency there is less exchange of the freely movable carriers around the electrode and this means, that in the bulb the heated matter is better confined to the neighborhood of the button. If a double bulb, as illustrated in Fig. 30, be made, comprising a large globe B and a small one *b*, each containing as usual a filament *f* mounted on a platinum wire *w* and w_1 it is found, that if the filaments *ff* be exactly alike, it requires less energy to keep the filament in the globe *b* at a certain degree of incandescence, than that in the large globe B. This is due to the confinement of the movable particles around the button. In this case it is also ascertained, that the filament in the small globe *b* is less deteriorated when maintained a certain length of time at incandescence. This is a necessary consequence of the fact that the gas in the small bulb becomes strongly heated and therefore a very good conductor, and less work is then performed on the button, since the bombardment becomes less intense as the conductivity of the gas increases. In this construction, of course, the small bulb becomes very hot and when it reaches an elevated temperature the convection and radiation on the outside increase. On another occasion I have shown bulbs in which this drawback was largely avoided. In these instances a very small bulb, containing a refractory button, was mounted in a large globe and the space between the walls of both was highly exhausted. The outer large globe remained comparatively cool in such constructions. When the large globe was on the pump and the vacuum between the walls maintained permanent by the continuous action of the pump, the outer globe would remain quite cold, while the button in the small bulb was kept at incandescence. But when the seal was made, and the button in the small bulb maintained incandescent some length of time, the large globe too would become warmed. From this I conjecture that if vacuous space (as Prof. Dewar finds) cannot convey heat, it is so merely in virtue of our rapid motion through space or, generally speaking, by the motion of the medium relatively to us, for a permanent condition could not be maintained without the medium being constantly renewed. A vacuum cannot, according to all evidence, be permanently maintained around a hot body.

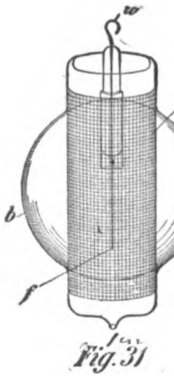


Fig. 31.—Showing the Inefficacy of a Metal Screen.

In these constructions, before mentioned, the small bulb inside would, at least in the first stages, prevent all bombardment against the outer, large globe. It occurred to me then to ascertain how a metal sieve would behave in this respect, and several bulbs, as illustrated in Fig. 31, were prepared for this purpose. In a globe *b*, was mounted a thin filament *f* (or button) upon a platinum wire *w* passing through a glass stem and leading to the outside of the globe. The filament *f* was surrounded by a metal sieve *s*. It was found in experiments with such bulbs that a sieve with wide meshes apparently did not in the slightest affect the bombardment against the globe *b*. When the vacuum was high the shadow of the sieve was clearly projected against the globe and the latter would get hot in a short while. In some bulbs the sieve *s* was connected to a platinum wire sealed in the glass. When this wire was connected to the other terminal of the induction coil (the E. M. F. being kept low in this case), or to an insulated plate, the bombardment against the outer globe *b* was diminished. By taking a sieve with fine meshes the bombardment against the globe *b* was always diminished, but even then if the exhaustion was carried very far, and when the potential of the transformer was very high, the globe *b* would be bombarded and heated quickly, though no shadow of the sieve was visible owing to the smallness of the meshes. But a glass tube or other continuous body mounted so as to surround the filament, did entirely cut off the bombardment and for a while the outer globe *b* would remain perfectly cold. Of course when the glass tube was sufficiently heated the bombardment against the outer globe could be noted at once. The experiments with these bulbs seemed to show that the speeds of the projected molecules or particles must be considerable (though quite insignificant when compared with that of light), otherwise it would be difficult to understand how they could traverse a fine metal sieve without being affected, unless it were found, that such small particles or atoms cannot be acted upon directly at measurable distances. In regard to the speed of the projected atoms, Lord Kelvin has recently estimated it at about one kilometre a second or thereabouts in an ordinary Crookes bulb. As the potentials obtainable with a disruptive discharge coil are much higher than with ordinary coils, the speeds must, of course be much greater when the bulbs are lighted from such a coil. Assuming the speed to be as high as five kilometres and uniform through the whole trajectory, as it should be in a very highly exhausted vessel, then if the alternate electrifications of the electrode would be of a frequency of five million, the greatest distance a particle could get away from the electrode would be one millimetre, and if it could be acted upon directly at that distance, the exchange of electrode matter or of the atoms would be very slow and there would be practically no bombardment against the bulb. This at least should be so, if the action of an electrode upon the atoms of the residual gas would be such as upon electrified bodies which we can perceive. A hot body enclosed in an exhausted bulb produces always atomatic bombardment, but a hot body has no definite rhythm, for its molecules perform vibrations of all kinds.

If a bulb containing a button or filament be exhausted as high as is possible with the greatest care and by the use of the best artifices, it is often observed that the discharge cannot, at first, break through, but after some time, probably in consequence of some changes within the bulb, the discharge finally passes through and the button is rendered incandescent. In fact, it appears that the higher the degree of exhaustion the easier is the incandescence produced. There seem to be no other causes to which the incandescence might be attributed in such case except to the bombardment or similar action of the residual gas, or of particles of matter in general. But if the bulb be exhausted with the greatest care can these play an important part? Assume the vacuum in the bulb to be tolerably perfect the great interest then centres in the question: Is the medium which pervades all space continuous or atomic? If atomic, then the heating of a conducting button or filament in an exhausted vessel might be due largely to ether bombardment, and then the heating of a conductor in general through which currents of high frequency or high potential are passed must be modified by the behavior of such medium; then also the skin effect, the apparent increase of the ohmic resistance, etc., admit, partially, at least, of a different explanation.

It is certainly more in accordance with many phenomena observed with high-frequency currents to hold that all space is pervaded with free atoms, rather than to assume that it is devoid of these, and dark and cold, for so it must be, if filled with a continuous medium, since in such there can be neither heat nor light. Is then energy transmitted by independent carriers or by the vibration of a continuous medium? This important question is by no means as yet positively answered. But most of the effects which are here considered, especially the light effects, incandescence, or phosphorescence, involve the presence of free atoms and would be impossible without these.

In regard to the incandescence of a refractory button (or filament) in an exhausted receiver, which has been one of the subjects of this investigation, the chief experiences, which may serve as a guide in constructing such bulbs, may be summed up as follows: 1. The button should be as small as possible, spherical, of a smooth or polished surface and of refractory material which withstands evaporation best. 2. The support of the button should be very thin and screened by an aluminum and mica sheet as I have described on another occasion. 3. The exhaustion of the bulb should be as high as possible. 4. The frequency of the currents should be as high as practicable. 5. The currents should be of a harmonic rise and fall, without sudden interruptions. 6. The heat should be confined to the button by inclosing the same in a small bulb or otherwise. 7. The space between the walls of the small bulb and the outer globe should be highly exhausted.

Most of the considerations which apply to the incandescence of a solid just considered may likewise be applied to phosphorescence. Indeed, in an exhausted vessel the phosphorescence is, as a rule, primarily excited by the powerful beating of the electrode stream of atoms against the phosphorescent body. Even in many cases, where there is no evidence of such a bombardment, I think that phosphorescence is excited by violent impacts of atoms, which are not necessarily thrown off from the electrode but are acted upon from the same inductively through the medium or through chains of other atoms. That mechanical shocks play an important part in exciting phosphorescence in a bulb may be seen from the following experiment. If a bulb, constructed as that illustrated in Fig. 10, be taken and exhausted with the greatest care so that the discharge cannot pass, the filament *f* acts by electrostatic induction upon the tube *t* and the latter is set in vibration. If the tube *o* be rather wide, about an inch or so, the filament may be so powerfully vibrated that whenever it hits the glass tube it excites phosphorescence. But the phosphorescence ceases when the filament comes to rest. The vibration can be arrested and again started by varying the frequency of the currents. Namely, the filament has its own period of vibration, and if the frequency of the currents is such that there is resonance, it is set easily vibrating, though the potential of the currents be small. I have often observed that the filament in the bulb is destroyed by such mechanical resonance. The filament vibrates as a rule so rapidly that it cannot be seen and the experimenter may at first be mystified. When such an experiment as the one described is carefully performed, the potential of the currents need be extremely small, and for this reason I infer that the phosphorescence is then due to the mechanical shock of the filament against the glass, just as it is produced by striking a loaf of sugar with a knife. The mechanical shock produced by the projected atoms is easily noted when a bulb containing a button is grasped in the hand and the current turned on suddenly. I believe that a bulb could be shattered by observing the conditions of resonance.

THE EWING MAGNETIC CURVE TRACER.[1]

BY PROF. J. A. EWING, F. R. S.

THIS instrument tests magnetic quality by exhibiting the curve which connects the magnetization B with the magnetizing force H in any magnetizing process. The curve is exhibited by the movement of a spot of light reflected on a screen by a mirror, which receives two component motions, one (vertical) proportional to B, and the other (horizontal) proportional to H. Fig. 1 shows the instrument in the form in which it is now made by Messrs. Nalder Brothers. The diagram, Fig. 2, shows the function of the various parts. The mirror is pivoted on a single needle-point, which leaves it free to turn both ways, and is connected by threads to the middle of two wires, A A and B B, in such a manner that when either of the wires sags the mirror suffers a corresponding deflection. The threads are kept taut by light springs, the tension of which is adjustable. The wires are stretched in narrow slots, forming gaps in two magnetic circuits, DD and C. One of these circuits, DD, is made up of the iron or steel to be examined, along with suitable pole-pieces and yoke, and the current which passes through the magnetizing coils of the circuit passes also through the stretched wire, B B, in the gap of the other magnet. The other magnet is constantly magnetized by a steady current, and a steady current also flows through the stretched wire A A. Hence, when the magnetizing current of D D is altered the wire B B sags out or in, and gives horizontal motions to the mirror which are proportional to the magnetizing force acting on D D. And when the magnetism of D D is altered, the wire A A sags up or down, giving vertical motions to the mirror which are proportional to the changes of magnetism.

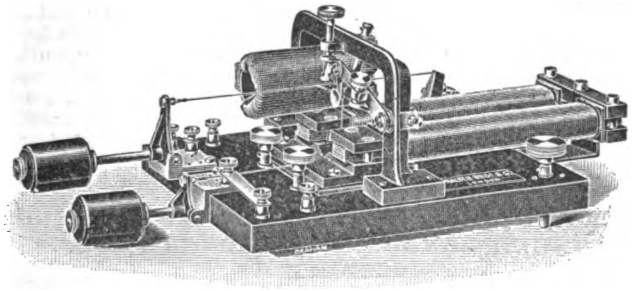
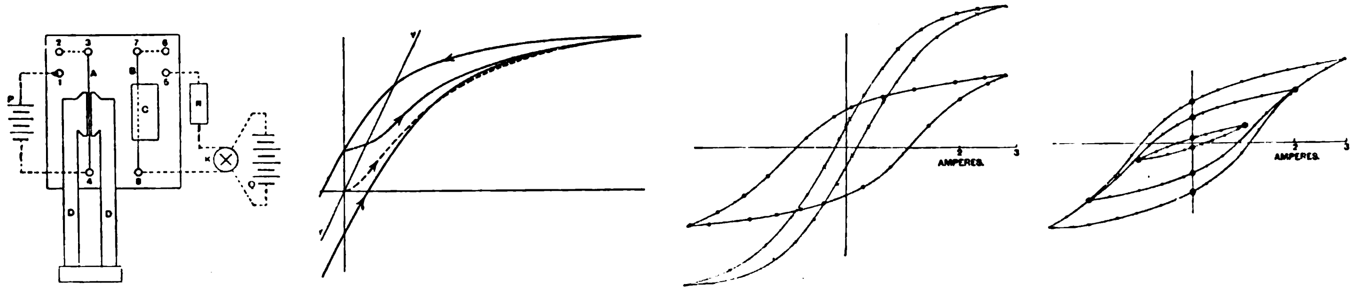


FIG. 1.—EWING'S MAGNETIC CURVE TRACER.

The samples to be tested form the arms D D. They may be solid rods, or rods built up of thin strips or of wire. The rods supplied with the instrument are of soft sheet-iron, built up of insulated strips, with a net cross-section about 1 inch by $\frac{1}{4}$ inch, and about 18 inches long. In preparing other rods for comparison of magnetic quality, the same dimensions are to be chosen as those of the standard rods. Clamps are provided at the pole-pieces to allow the rods to be readily inserted and removed.



FIGS. 3, 4, 5 AND 6.—DIAGRAM OF EWING'S CURVE TRACER CONNECTIONS AND MAGNETIC CURVES OBTAINED.

The same constant current will serve for the wire A A, and for the magnetizing coil of the tubular magnet C. A current of about four amperes will serve well, but more or less may be used, according to the amount of movement which it is desired to give to the mirror. The amplitude of the movements can also be regulated by shifting in or out the weights on the bell-crank levers which keep the stretched wires tight. For high-speed work the wires should be kept very tight, and a small mirror should be used. The magnetizing current must be made to vary in a continuous manner; not by sudden makes and breaks. When these precautions are taken, magnetic cycles may be performed so rapidly that the reflected light appears on the screen as a continuous curve. A special commutator is supplied to allow of rapid but gradual variations and reversal of the magnetizing current. It consists, essentially, of two fixed and two revolving plates of zinc, immersed in a solution of zinc sulphate.

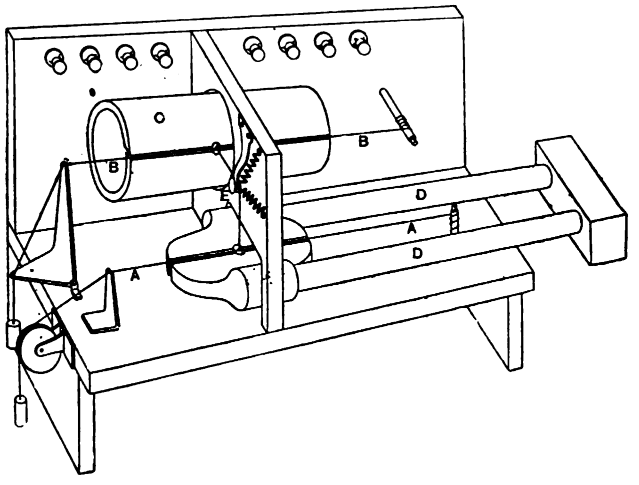


FIG. 2.—EWING'S MAGNETIC CURVE TRACER.

In ordinary testing, it is more convenient to make the magnetic changes occur slowly, and to mark with a pencil the successive positions of the spot on the screen. A sheet of paper on a small drawing-board, set up against a wall or other vertical support, is a vertical screen. The source of light may be an ordinary galvanometer lamp, furnished with a pair of cross-wires instead of the usual single wire. For high-speed work, a small spot of light is necessary, which is obtained by placing a screen with a small hole in it just in front of the lamp. Horizontal and vertical datum lines are marked by moving (by hand) the wires B B and A A respectively, and marking the path of the spot. A variable resistance is to be inserted in the magnetizing circuit of D D, to allow successive points of the magnetizing curve to be obtained; two zinc plates suspended near together in a weak solution of zinc sulphate, in such a way that they can be more or less deeply immersed, will serve well for this purpose. A rapid commutator is also to be put in this circuit, to allow the specimens under test to be demagnetized by rapid reversals of continuously-diminishing magnetizing force, if it is wished to determine the curve of *initial* magnetization.

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[1] Abstract from the London *Electrician*.

Fig. 3 shows the electrical connections with the terminals as they are placed on the slate base of the instrument.

Terminals 1 and 2 are those of the coil which magnetize the tubular magnet C; terminals 5 and 6 are those of the main magnet coils on D D. The constant current is supplied by P, and, taking the course 1, 2, 3, 4, passes in series through the magnetizing coil of C and the stretched wire A. The variable current is supplied by Q, through the commutator K and adjustable resistance R. Taking the course 5, 6, 7, 8, it passes through the main magnetizing coil and the stretched wire B. The copper strip which is used to connect 2 with 3 may be put between 1 and 3 instead, 2 and 4 being then the battery terminals in that circuit. The effect of this is to change the general slope of the figure on the screen from right to left, or *vice versa*. One of the two arrangements is right when an ordinary screen is used; the other is right when the screen is a piece of tracing paper or ground glass, viewed from behind.

Fig. 4 is an example of the curves obtained by the instrument shown in Fig. 1. It is a copy of one-half of a cyclic curve of reversal, along with the initial curve taken after demagnetizing the specimen by reversals, and also the curve obtained by reapplying the magnetizing current after it had been reduced from its maximum to zero. Owing to the existence of an air gap in the magnetic circuit under test, the diagram is sheared over to the right, and true values of the magnetic force would be found by measuring horizontal distances from some such line as Y Y, instead of from the vertical line. This shearing does not affect the *area* enclosed by the cyclic curves of reversal, and need not, therefore, be taken account of in measuring the comparative amounts of energy dissipated by magnetic reversals in different specimens, or in the same specimens with different values of the magnetism.

In Fig. 5 the higher and narrower curve gives the effect of carrying the standard soft iron bars through a magnetic cycle by reversing a current of three amperes in the magnetizing coil. The flatter and wider cycle on the same diagram was obtained (with the same strength of magnetizing current) after a pair of steel bars had been substituted for the standard soft-iron bars.

Fig. 6, again, shows three cycles obtained with a pair of steel bars, the limits of the magnetizing current being three amperes, two amperes, and one ampere respectively. Curves of this type show how readily the instrument may be employed to determine (from the enclosed areas) the relative amounts of heating due to magnetic reversal under different grades of magnetizing force, or with different values of the limiting magnetization. In these instances the cycle was gone through quite slowly, a pause being made at each of the marked points. When the cycle is gone through comparatively fast, the presence of time lag becomes very manifest, especially when the bars are solid and when the material is soft iron. It is obvious from the behavior of the spot of light in such experiments that the time lag is due to no peculiarity of the instrument, but is a genuine feature of the magnetizing process.

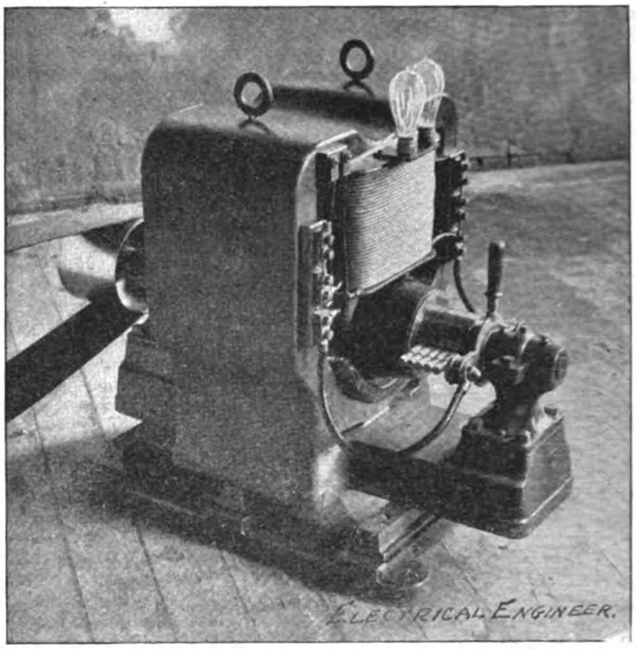
In addition to its use for determining areas such as those of Figs. 5 and 6, for comparing the magnetic qualities of different samples of iron, and for investigating the properties of magnetic curves generally, the instrument may be used as a galvanometer by making the current to be measured pass through either of the stretched wires, while the magnet, in the slot of which the wire is stretched, is kept in a constant state of magnetization. This will be found useful in cases where an extremely dead-beat indication is wanted, and by making the spot of light register its position photographically on a moving plate or paper, satisfactory records of rapidly fluctuating currents may be obtained.

THE MUNCIE ELECTRICAL WORKS' "IRON-CLAD" DYNAMOS.

THE accompanying engraving represents the "Iron-Clad" machine adopted as their standard by the Muncie Electrical Works. The machine has been designed with great care and no detail which might contribute to its efficiency or wearing qualities has been overlooked.

As will be seen, the magnet frame is one complete casting, bringing the leakage down to a minimum by doing away with all joints. There is but one field coil, the armature being placed beneath it, admitting of the lowest possible centre of gravity, and thus obviating injurious effects from vibration. The field coil is wound in three sections, so that in case of accident it would rarely be necessary to replace but one.

The brush holders are of a new and simple design, so arranged that either holder complete can be removed without disturbing the yoke, or in case it should be necessary to replace one or more of the carbons, of which there are five to each holder, any one of the separate sockets containing the carbons can be removed and replaced without interfering with the operation of the machine. The boxes are self-oiling and aligning, with phosphor-bronze bearings, and are fitted with sight oil gauges. The shaft is of the best grade of steel and extra large in diameter.

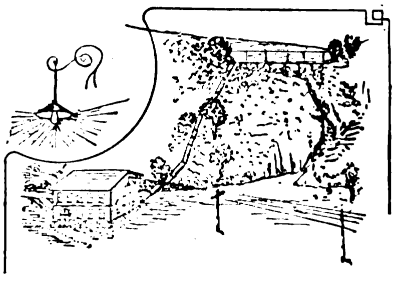


THE MUNCIE ELECTRICAL WORKS IRON CLAD DYNAMO.

The armature is built up of the highest grade of iron and is of very low resistance. The commutator is of tempered copper and thoroughly insulated with the best grade of mica. The connection boards are of marbleized slate arranged in the simplest manner possible, and the rheostats have metal frames with slate base, making them thoroughly fireproof. The machines, as a whole, have been designed with the utmost care both mechanically and electrically, and for slow speed. The engraving illustrates an 8¼ k. w. generator which has an efficiency of 90 per cent. according to actual test. It runs at 1,100 revolutions per minute, and is so proportioned as to admit of the commutator running entirely free from sparking, there being no lead of brushes between no load and its full capacity. These machines are built in sizes ranging from ½ to 50 k. w.

The Muncie Electrical Works are situated at Muncie, Ind., and are thoroughly equipped for the manufacture of dynamos for arc and incandescent lighting, power generators and motors, both for stationary and for railway work. The officers of the company are: F. A. Van Namee, president; James Chamberlin, general manager; and F. C. Field, electrical engineer. The excellent design and execution exhibited in their dynamo illustrated above augurs well for the success of the company.

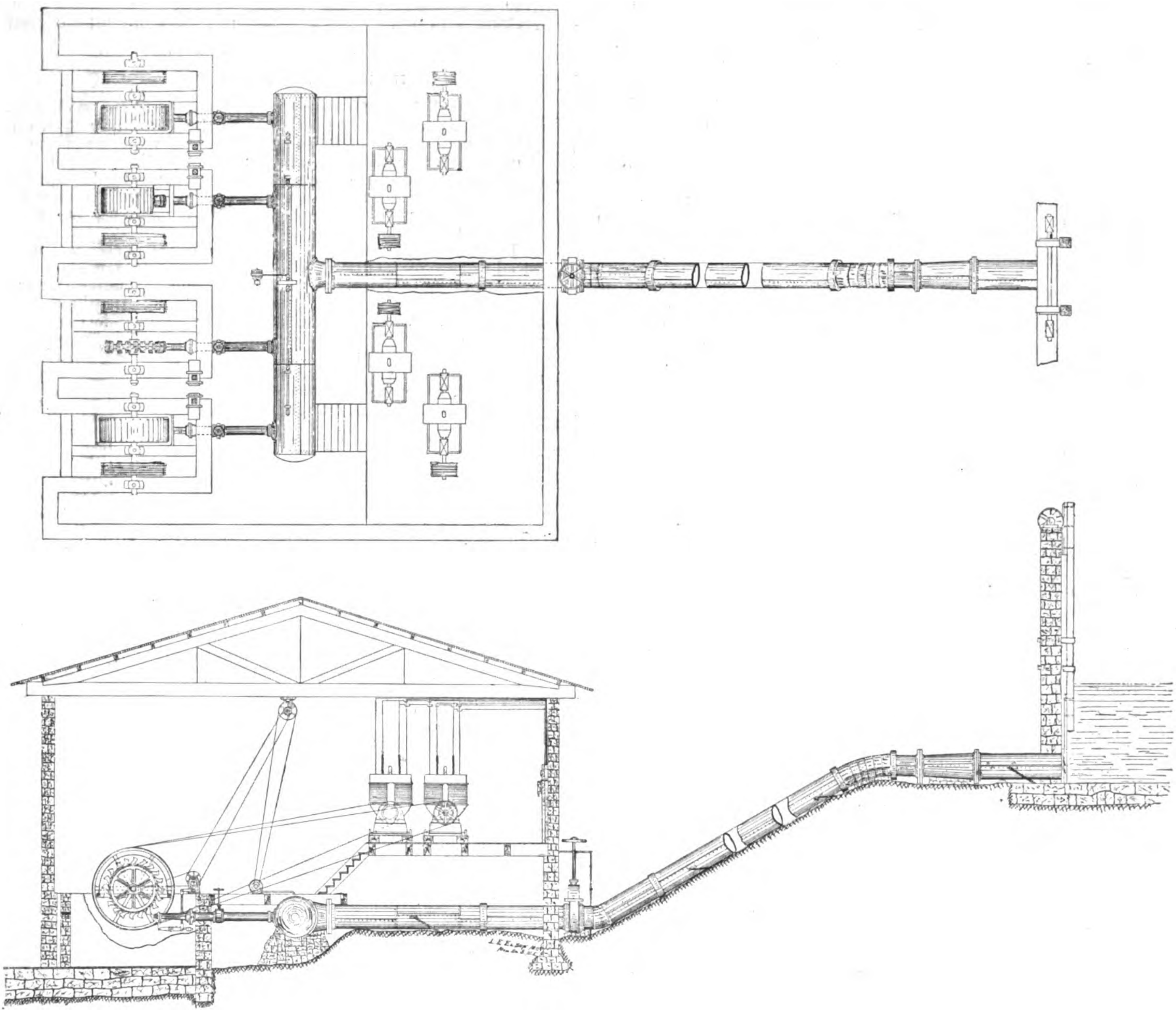
ELECTRIC TRANSMISSION FOR MOODIE'S GOLD MINING AND EXPLORATION CO., LTD.



Pipe Line for Pelton Wheel.

THE accompanying illustrations show the power plant which is being installed for the above-named company for the purpose of operating various classes of machinery used in their different mines. The plant is designed to utilize the water of the Queen's River, near Barberton, South African Republic.

There are six mines on their claim which require power for mining and reduction purposes. These mines are situated within a radius of four miles from the generating station. The capacity of the plant will be 500 h. p., which is developed by four Pelton wheels, with a capacity of upwards of 125 h. p. each, running under 142 feet effective head. The minimum flow of the Queen's River is 2,800 cubic feet of water per minute, and the surveyed head is 150 feet. The water is diverted from the river in the usual way by a ditch and flume, and from this flume a pipe extends down the grade a distance of 510 feet, as shown in the vignette engraving.



Figs. 1 and 2.—Electric Transmission Plant of Moodie's Gold Mining and Exploration Co., Ltd., in the Transvaal, South Africa.

The arrangement of the pipe line is as follows: the first third of the line which is connected to the fore bay or pressure box, is 30 inches in diameter and made of No. 12 B. W. G. steel. The next third 28 inches in diameter and made of No. 14 steel, and the remainder, 26 inches in diameter, made of No. 14 steel. The lower end of the main line terminates in a receiver which distributes the water to the several wheels. The loss of head by friction in the above arrangement is eight feet, while carrying sufficient water for 500 h. p. This leaves 142 feet effective or running pressure. The pipe is double-riveted in the longitudinal seams, the same kind that is extensively used in California and the Rocky Mountain mining districts.

The water wheels are six feet in diameter and make 150 revolutions per minute. They are fed by single nozzles of the Pelton deflecting type. The nozzle tips through which the water supply is discharged are 4¼ inches in diameter and vent 575 cubic feet of water each per minute, the combined power of the four wheels being 500 h. p. The speed of the wheels is controlled by a Pelton differential governor which operates directly upon the deflecting nozzles. The dynamos are four in number, and are driven direct from the water wheel shaft by sheaves six feet in diameter, each sheave grooved for five 1¼ inch diameter cotton ropes.

The illustrations give a very good idea of the construction of electric transmission plants adapted for high and medium falls.

ELECTRICITY FOR CANAL BOAT PROPULSION.

The recent appropriation of $10,000 by the State of New York for the purpose of experimenting with electricity as a motive power for the propulsion of boats upon the canals of the State has given quite an impetus to workers in this field, and we shall probably see active experiments begun in a short while. In the meantime, inventors are busy working out details for such a system. In a patent just issued to Samuel W. Gear, of Buffalo, the inventor describes such a system, consisting of a generating station and conductors placed over the canal from which the current is taken by a trolley on the boat, which also carries a motor for the operation of the screw propeller. The system also embodies a laterally adjustable return wire that carries the current back to the generator. In order to provide for propelling boats in both directions, two wires are employed and also two return wires. A third wire is also arranged between the others so that it enables a fast boat to pass a slower boat going in the same direction. The conductors are supported on guy wires in such a manner that they can travel laterally to conform automatically to any motion of the boats.

ELECTRIC RAILWAY DEPARTMENT.

A LARGE ELECTRIC RAILWAY SYSTEM FOR INDIANA.

A SPECIAL dispatch from Indianapolis of June 5, says:—"The Central Indiana Electric Railway Company, which has filed articles of association, contemplates an electric system on a larger scale than has as yet been attempted in this country. The capital stock is $4,500,000. The officers are J. T. Baker, president; W. B. Keep, first vice-president; Thomas Wilkinson, second vice-president; N. D. Pontius, secretary; R. T. Wilkinson, treasurer, and Dr. T. A. Gesner, general manager. The central point of the proposed system, at which will be located its general offices, power house, and car and machine shops, is Noblesville, 20 miles north of this city.

The ramifications of the Central Indiana Electric Railway Company will extend to the principal cities of the Indiana gas belt and its outskirts. A double-track system, according to present plans and specifications, is to extend from Noblesville to Indianapolis. A line to the west will extend to Lafayette by way of Frankfort. A line north will reach Kokomo and branch thence to Logansport and Peru. Another line northeast will connect with Elwood and thence with Marion and Fort Wayne. Another will extend to Muncie by way of Anderson.

To complete this system will require about 300 miles of main track. The company proposes to operate a city railway system at Noblesville, and the council of that city has granted a franchise for 30 years. The proposed plan contemplates through and local trains for passenger traffic, with express and mail cars, as well as freight trains, and it is said that passengers and express and freight matter will be transferred as rapidly as on any of the steam railroads of the State. With the perfection of electrical appliances the management expects in time to distance the steam railway companies in speed and dispatch.

The promoters of the project assert that they have enlisted capital from Philadelphia, Chicago, and London, and that ample means are at hand for the construction and equipment of the lines. The trolley system is to be employed at the start, but if the storage battery system is perfected so as to become practicable, it will be substituted. The work of construction is to be commenced at once, and the line between Noblesville and Indianapolis is to be in operation by early Autumn.

HUTCHINS' TROLLEY WIRE CUT-OUT.

ALTHOUGH no authentic case of death or permanent injury to a human being from a shock due to a trolley wire is on record, the fears of the public on this score must nevertheless be considered, and, as a result a number of devices have been conceived for automatically cutting off the current from the trolley wire as soon as it is displaced from its normal position.

The most recent arrangement designed for this purpose is that recently patented by Mr. A. E. Hutchins, of this city. In this system overhead wires are suspended in sections between fixed supports, which supports may also be suspended. To these supports are attached pivoted-conducting arms or levers. A strain that is imposed by a spring on one part of the pivoted arm, pulls against the strain of a normally suspended wire, and when that strain of the wire is released, by its breaking, the spring instantly moves the pivoted lever and breaks its engagement with the live part of the conductor, which live part has again a pivoted arm with a spring that hastens the disengagement from the broken conductor, which is thus instantly converted into a "dead," harmless wire.

In this safety switch the inventor has provided an automatic shunt, whereby the electric service may be continued around the affected part. A means for signaling an alarm is also provided, that notifies the station of the broken wire. One form of bridge is shown whereby a traveler, like a trolley wheel, may pass over without any interruption or inconvenience to the electric railway service.

CHANGING A SHORT STEAM ROAD IN MILWAUKEE TO ELECTRICITY.

THE MILWAUKEE & WAUWATOSA MOTOR RAILWAY COMPANY, which now has a capital of $300,000 intends to change from steam to electricity. Mr. A. B. Myers, the secretary of the company writes us as follows:—This company was organized July, 1891, and began operating July 15, 1892. The road bed covers about 3½ miles. We built an extension to the State Fair grounds last August, which is two miles further. We are about to extend the last-named line to another suburb, which will give us in all about seven miles of double track. We are using steam motor power but have issued $100,000, in bonds of $1,000 each, which, when we sell them, will give us the funds to equip our line with electricity. By actual count, we carried the past week over 8,000 people on the line. Our buildings are of wood. We have a repair shop, car house and depot at one end, and at the other end, we have a small house. Our right of way is worth $150,000. Our 2,100 foot viaduct is worth $80,000, and is such a fine piece of workmanship that people come from all over the state to view it.

RUNNING WITH A HUMAN TROLLEY.

THE novel sight of a man taking the place of the trolley on an electric car was seen last night, says the *Baltimore Sun*, on the Lake Roland Elevated Railway. The trolley on one of the large electric cars, in crossing Lexington street at North street had its trolley wheel caught in the wire, and the entire trolley apparatus was torn off, falling to the street. The accident happened at a time when travel over the road was heavy, and it was necessary to prevent a blockade.

Lineman William Scott was equal to the occasion. He procured a piece of insulated wire, and after stripping each end of the insulating material connected one end through the car roof and standing on the top of the car held the other end against the trolley wire. A connection being thus made the car was run over the elevated structure to the car barn at Walbrook without accident to Mr. Scott or delay to the other cars. Mr. Scott's position was a novel one and startled persons who are unused to electricity, as he stood on top of the car amid myriads of sparks and illuminated by lightning-like flashes from the trolley wire.

NOW COMES THE TROLLEY BUZZ.

JUST as constant use of the telephone was said to produce aural affection popularly known as "telephone ear" so is the overhead wire system of electric transit being held responsible for an affliction which in Philadelphia is denominated "the trolley buzz." It is a nervous affliction resulting from the combination of hiss and roar which is a prominent feature of the "cheap and nasty" system of rapid transit. It worries the possessors of fine sensibilities, is dangerously annoying to the sick and prevents the robust from sleeping as they ought to sleep. "Have you got the trolley buzz?" is a common query in the Quaker City, and if greedy corporations can have their way here the same inquiry will take the place of the Oriental "How is your liver?" or the American "How d'ye do?"—*Washington Star.*

TROUBLE WITH RAILWAY MOTORS.

WILL you kindly give us information on this point:

What is the cause that two 15 h. p. S. R. G. 30 type motors develop from 25 to 30 h. p. while the car is moving empty on a level track? Our motors run hot with a small load and on testing them with instrument of Weston standard they developed as above.

J. H. HERTZ,
Secretary Macon and Indian Spring Railway Co.

MACON, GA., May 29, 1893.

The trouble complained of is most probably due to the fact that the motors on the car work against each other, that is to say, the one taking the entire current and driving the other as a dynamo. The current measurements were probably taken with only one ammeter. If two ammeters had been employed to measure the current in each motor separately, it would probably have been found that one machine takes all the current. In all probability one or more of the field coils are short-circuited, or the field unbalanced in some other way. A thorough inspection of the machines will probably result in an eradication of the fault. It seems hardly probable that excessive friction due to bad gearing would account for the high consumption of power noted on a level.

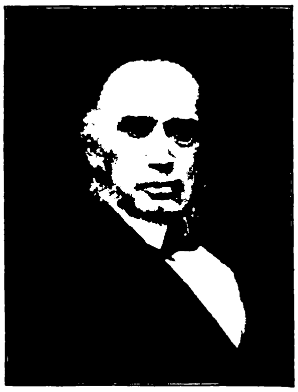
EDS. E. E.

A BIG HAUL.

THE Dunkard Society of the United States, met last month at Muncie, Ind., and on Sunday, May 21, the Citizens Street Railway Company carried 17,500 people in ten hours with six motor cars and two trailers. On some of the eight seat open cars, the company loaded 110 people. Supt. W. C. Gotshall has never heard of anything that beats such a record, and regards it as remarkable.

OBITUARY.

DR. M. HIPP.



Matthias Hipp.

NEWS has reached this country that, after long suffering, a man has passed away, whose achievements in electrotechnics have won for him a place of honor among the pioneers in the electrical industries of Europe.

Dr. Matthias Hipp was born about 1815, in Blaubauern, Würtemberg, Germany. The son of a miller, he was early obliged to earn his livelihood, which, together with a natural physical defect making him lame for life, proved to young Hipp a stimulus for greater efforts. All free moments were spent in studying mechanical problems, and curiously enough, most of his efforts were in the direction of fine and delicate apparatus. After having gone through the schools of Reutlingen, he learned the trade of watchmaker, in which he acquired distinction through his originality and thoroughness of work. These, in fact, were the characteristics of his life.

The opportunities offered by the advent of electric telegraphy were gladly seized by Hipp, and we find him engaged in building Morse instruments, keys, relays, etc. He was one of the first to construct a Morse recorder which printed the dots and dashes in ink on a running tape. In 1852 he left his native country and permanently settled in Switzerland, where he at first held a position as director of the telegraph workshops in Berne. A number of very interesting telegraphic instruments were then produced; one, the "Rechenschreiber," by means of which messages could be recorded over great distances without relays, the instrument being a relay of itself, a delicate magnet engaging the printing apparatus with a continuously revolving clockwork, which furnished the power for printing as well as for feeding the tape. Another notable apparatus of this period was a writing telegraph, transmitting and receiving messages in script type, the receiver and transmitter simultaneously tracing universal signs which contained all the lines that make up any and all of the English alphabet. The receiver only printed such parts of the universal sign which were depressed by the operator on the transmitter. The transmitter was operated like an ordinary pen.

While engaged in this work Hipp conceived the application of electricity to time measurement, and laid the foundation for this class of work, in which he stands as pioneer. In 1857 he installed an electric regulator in the Federal Building at Berne, actuating a number of secondary clocks. His previous experience as watch and clock maker specially fitted him for the working out of time telegraphy, and, when in 1860 he removed to Neufchâtel, to organize a company bearing his name, he had a system of time telegraphy well worked out in all its details, and which has stood the test of thirty years' daily use, and in a country which, being the home of the watch industry, is apt to be more critical than the average. He also constructed his chronoscope, which measures one one-thousandths of a second accurately within 5 per cent., and which instrument is employed all over the world. His chronograph, barograph, thermograph, hydrograph, udometers, anemometers and seismographs are used in many of the principal observatories in Europe and abroad. He devised the Hipp escapement, consisting of a steel spring, its vibration emitting a musical sound by which it is adjusted and tested.

In 1853 he constructed an electric loom, which replaced the perforated cards used in the Jacquard loom, by tinfoil patterns marked with insulating ink. These patterns acted as a contacting devise for a number of magnets controlling the movements of the warps. Complicated patterns of any kind, could by this means be quickly produced. A large piece of cloth woven on this loom in the presence of the King of Italy, procured for Hipp a decoration.

In 1860 he constructed an electric piano in which a roll of perforated paper passed under a set of contacts which, in connection with the keys of the piano, reproduced any kind of music. This piano was far from having the peculiar mechanical touch often found in instruments of this kind. Not only was the sequence of the notes and speed variable, but the strength of the note could be controlled and the quality of the music depended largely upon the accuracy and talent of him who made the rolls.

As mentioned before, his chief work was the construction of accurate time regulators and the distribution of such time over large districts. The notable elements in his system, were, first, polarized secondary clocks with a long travel of armature, requiring but weak currents, but of some duration and in the same direction, to move the hands. Second, almost entire elimination of sparks on the contacting device in the distributing regulators.

The first public system was installed in 1862 in Geneva, starting with one main regulator and 15 secondary clocks, later increased to double; then followed Neufchâtel with a regulator and 20 clocks, also increased to double; then Zürich, Milan, etc., not less than nine municipalities being fitted up in the space of ten years, aside from a large number of private administrations, hotels, etc. But the greatest step was made when it was found necessary to supply the large centres of the watchmaking industry in the western part of Switzerland with correct time. From the observatory in Neufchâtel, time has been, and is being furnished to Berne, Chaux-de-Fonds, Locle, Ponts, Fleurier and St. Croix. The means of receiving such time, is another invention of Hipp's, the "coincidence pendulum." This latter is, in reality, a time vernier. It is an ordinary pendulum driven by springs or weights, but so adjusted as to make 61 beats per minute; thus each swing of the pendulum takes one-sixtieth of a second of time, as against one second in an ordinary pendulum. The pendulum is held by a magnet, which, upon the passage of the current releases the former. When the beats at the distributing pendulum and those of the coincidence pendulum coincide, the number of sixtieths of a second's difference can be read on the dial of the coincidence clock, and the distributing pendulum can be regulated accordingly. The coincidence clock, being kept swinging, will act as a tally of the correction, making a second signal unnecessary. The maximum daily variations in this distributing pendulum have never exceeded one-half of a second.

Hipp's electric pendulums, continuously kept going by an ingenious contacting device, early attracted attention, and to the principle contained therein is due one of the most accurate time pieces known, the "astronomical pendulum," which has been the crowning triumph of Hipp's labors. This pendulum has been the subject of a lengthy communication to the Société des Sciences Naturelles de Neufchâtel, by Dr. Hirsch, the director of the Observatory, under whose superintendence the pendulum has been in daily use for a number of years. It was also exhibited at the International Exhibition at Paris in 1881, where it received a gold medal.

The pendulum proper is suspended on springs and knife edges, enclosed in a hermetically-sealed glass tube, which is kept under constant pressure by means of an exhaust pump, kept going by the Hipp electric contacting device, and furnishing contacts every second to actuate the dials of different parts of the Observatory. No oil whatever is employed; temperature and pressure are kept constant. The average daily variation for six months' continuous use is five-hundredths of a second, approximately, which figure includes the errors in two observations of the time and the variation of the personal equation of the observer. A complete working plant, composed of the distributing pendulum, coincidence clock and eight secondary clocks, was exhibited at the Centennial at Philadelphia.

Dr. Hipp was the typical, hard-working man patiently struggling along against obstacles. Naturally very modest, he always failed to attract attention on account of his retiring manners. Many inventions now well known, have been made by him in quiet and lost to the world by his being unacquainted with the financial methods necessary for carrying them out. As an example of this may be mentioned the repeating rifle as introduced by Dreyse, which, 18 years previous to its introduction, was invented by Hipp and submitted to the French and English Governments but refused, either through lack of appreciation on the part of the ministers, or insufficient knowledge of the proper official etiquette by the humble inventor.

As a director of the works he was highly revered by all his employees for his generosity, love of justice and fair play. In his home life, those who were favored were able to witness one of those rare, lasting honeymoons. The loss of an only son at a promising age accelerated the break-down of an otherwise strong physique. He leaves a mourning widow and three daughters.

H. L.

PERSONAL.

MR. GEO. CAWLEY.

MR. CAWLEY, chief editor of *Industries*, is about to retire from the position which he has held since our contemporary was started, some seven years ago. At that time it was thought by many that the needs of technical readers were generally well met by older journals, but in spite of this view, and of the usual difficulties connected with the early life of nearly all journalistic ventures, Mr. Cawley has succeeded in piloting *Industries* to an established position in the field of technical journalism. At the beginning of this year a change occurred in the proprietary of our contemporary, and this, we understand, has led Mr. Cawley to tender his resignation. After concluding his editorial work, he intends carrying on business as consulting engineer, and has taken offices at 29 Great George street, Westminster, S. W.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JUNE 13, 1893.

Alarms and Signals :—

Burglar Alarm System, S. Stromberg, Chicago, Ill., 499,261. Filed Feb. 11, 1893.

Relates to connections for windows, doors and other openings.

Electric Signaling Apparatus for Elevators, C. G. Armstrong, Chicago, Ill., 499,411. Filed Jan. 23, 1893.

Electric Hinge, W. S. Hull, Sheffield, Ala., 499,428. Filed Nov. 16, 1892.

For use in safes, vaults and other structures where electric alarms are employed.

Electric Bell, J. L. Moore, New York, N. Y., 499,305. Filed June 6, 1892.

Recorder, J. T. Todd, Newark, N. J., 499,610. Filed May 24, 1892.

For use in a telemeter system.

Distribution :—

Safety Device for Systems of Distribution, H. C. Wirt, Boston, Mass., 499,275. Filed March 16, 1892.

Specially adapted for high tension and alternating current systems. Claim 5 follows:

The combination of an electric generator normally grounded at an intermediate point between the circuit terminals and adapted to establish a short-circuit upon the occurrence of a ground on the line as described, with an indicator at the central station responding to, and indicating the existence of such a short-circuit.

Dynamos and Motors :—

Commutator for Dynamo Electric Machines, H. F. Parshall, Lynn, Mass. 499,350. Filed Jan. 13, 1893.

Each segment is composed of a base portion of one metal and a contact portion of another and better-conducting metal, dove-tailed into the base portion. Adapted for the ready removal of any segment for repairs.

Alternating Current Generator, W. Stanley, Jr., and J. F. Kelly, Pittsfield, Mass., 499,446. Filed Jan. 9, 1893.

Relates to details of construction of both single-phase and bi-phase generators.

Regulator for Electric Machines, J. C. Henry, Westfield, N. J., 499,544. Filed Sept. 2, 1892.

Particularly adapted for constant-current motors. See page 598.

Ignition :—

Electric Gas-Lighting Apparatus, T. W. Lane, Boston, Mass., and C. E. Lee, Chicago, Ill., 499,297. Filed Feb. 8, 1892.

Improvements in the Tirrell apparatus.

Electric Gas-Lighting Apparatus, T. W. Lane, Boston, Mass., 499,298. Filed Feb. 15, 1892.

Electric Igniting Device, W. H. Russell and G. E. Russell, Jersey City, N. J., 499,596. Filed March 9, 1893.

A combined cigar-cutter and lighter.

Lamps and Appurtenances :—

Electric Arc Lamp, R. M. Hunter, Philadelphia, Pa., 499,676. Filed March 28, 1893.

Employs a single-holder frame carried by a single rod to operate a double-carbon lamp.

Electric Light, G. Sautter, Paris, France, 499,473. Filed Jan. 5, 1892.

An arc lamp with reflector and projector, for search light and similar uses.

Measurement :—

Electrical Measuring Instrument, E. Weston, Newark, N. J., 499,313. Filed Oct. 3, 1892.

Relates to the class of instruments in which a coil, supported and vibrating in a field of force, is caused, by the passage of a current through it, to move over an angular distance depending upon difference of potential.

Metallurgical :—

Process of Magnetic Separation and Apparatus Therefor, R. H. Sanders and C. T. Thompson, Philadelphia, Pa., 499,253. Filed Dec. 27, 1892.

Feeds stock to the upper portion of an overhanging surface magnetically charged, whereby the ore is detained and the gauge is permitted to drop off; the accumulating ore descends and drops off from the lower edge of the overhanging surface.

Metal Working :—

Method of and Apparatus for Uniting Metals, J. H. Bassler, Myerstown, Pa., 499,277. Filed Dec. 1, 1892,

Employs a fillet of aluminum, or an alloy of aluminum in the joint, and employs an electric current, or an electric arc to fuse the joint.

Method of Electrically Welding Metals, C. L. Coffin, Detroit, Mich., 499,518. Filed Sept. 25, 1890.

Consists in heating a short section of material, heating the extremities of the articles to be welded by pressing the ends of the same against the short heated section, and then completing the weld.

Apparatus for Punching Metal, C. L. Coffin, Detroit, Mich., 499,519. Filed Feb. 28, 1893.

Heats the points at which holes are to be punched by an electric current; while one hole is being punched the next point is being electrically heated.

Method of and Apparatus for Electrically Welding Sheet Metal, C. L. Coffin, Detroit, Mich., 499,657. Filed Oct. 18, 1892.

Miscellaneous :—

Electric Hose Coupling, H. Sargent, Cambridge, Mass., 499,254. Filed Feb. 21, 1893.

System of Propelling Canal Boats by Electricity, S. W. Gear, Buffalo, N. Y., 499,321. Filed Jan. 26, 1893.

A trolley system, the trolley wire being arranged to shift laterally with the movement of the boat. See page 607.

Electric Switch, J. F. McElroy, Albany, N. Y., 499,363. Filed Nov. 16, 1892.

Specially designed for use in connection with heating circuits in electric cars.

Strong Current Protector, C. D. Haskins, Brooklyn, N. Y., 499,425. Filed Sept. 9, 1890

Employs the expansion or elongation of a wire heated by an unduly strong current to close a ground contact.

Relay Fuse Block, G. T. Voorhees, Boston, Mass., 499,485. Filed August 23, 1892.

Provides means for bringing successive portions of a continuous fuse into operative contact with terminals.

Cut-Out, P. J. Barrett, Boston, Mass., 499,497. Filed April 3, 1893.

A fuse cut-out.

Apparatus for the Production and Inhalation of Ozone, M. P. Oudin, Paris, France, 499,572. Filed Dec. 10, 1891.

Consists in the use of a glass tube hermetically closed, enclosing air or a gas at a pressure other than atmospheric pressure, which tube is connected with one of the poles of a source of electricity, the other pole of which is connected to insulated metal plates located in close proximity to the glass tube.

Multiple Fuse Block, G. T. Voorhees, Boston, Mass., 499,614. Filed Sept. 1, 1892.

Switch, G. W. Russell, Jr., Denver, Colo., 499,646. Filed April 7, 1893.

A three-point switch.

Electric Fuse Block, T. J. Fay, New York, N. Y., 499,664. Filed Feb. 11, 1891.

Electric Magnetic Blanket, N. A. Renstrom, Omaha, Neb., 499,681. Filed April 15, 1893.

Railways and Appliances :—

Safety Support for Trolley Wires, H. K. Whitner, Chicago, Ill., 499,270. Filed Feb. 6, 1893.

Conduit Electric Railway, W. R. De Voe, Shreveport, La., 499,374. Filed Oct. 28, 1892.

Employs a trolley in the conduit revolving in a horizontal plane, bearing upon the conductor on one side and upon a guide-rail on the other.

Overhead Trolley Wire Switch, R. M. Hunter, Philadelphia, Pa., 499,461. Filed Feb. 2, 1893.

Electromagnetic Car Brake, J. C. Henry, Westfield, N. J., 499,543. Filed August 8, 1892.

Claim 1 follows:

An electric train-brake, comprising a dynamo on each car, a magnetic clutch connected with said dynamo, and brake gearing operated by said clutch.

Trolley Wire Hanger, C. B. Elliott, Boston, Mass., 499,662. Filed Aug. 8, 1892.

Gearing for Electric Railway Cars, J. C. Henry, New York, N. Y., 499,682. Filed April 29, 1892.

Adapted to enable the grading of the rate of transmission of power to the axles in an inverse ratio to the work done or the load. At slow speed the traction is distributed over all four wheels. Provides manual means for applying the secondary transmitting mechanism to the second or another axle and for varying the positiveness of connection with the first axle.

Telephones and Apparatus :—

System of Wiring Multiple Switchboards, C. H. Wilson, Chicago, Ill. 499,693. Filed Oct. 8, 1888.

Relates to the convenient arrangement of cables behind telephone switchboards for readily making connections with spring-jacks.

LEGAL NOTES.

LIABILITY FOR A DELAYED MESSAGE.

A VERDICT for $234.50 has just been recovered by James Reilly in the New York City Court, before Judge Van Wyck, in an action against the Western Union Telegraph Company. Mr. Reilly owns a sloop named *Paul and Stella*, which on September 13, 1892, was at Bath Beach, L. I. On that day the weather was stormy, and Mr. Reilly sent a telegram from the Western Union office at Grand and Hester streets, at 12:15 p. m., to a man in charge of the boat, with orders to put it in a place of safety. The telegram was not delivered until 2:30, and in the meantime the boat was badly damaged. The Western Union when sued contended that it was absolved from liability on account of the contract on the message blank. The court and jury, however, rendered a verdict for the full amount, with interest and costs.

SOCIETY AND CLUB NOTES.

PAPERS FOR THE INTERNATIONAL ELECTRICAL CONGRESS.

PROF. H. S. CARHART, honorary secretary of the International Electrical Congress at Chicago, informs us that Mr. W. H. Preece will read a paper entitled "Signaling Through Space by Means of Electromagnetic Vibrations," and Prof. W. E. Ayrton, one on "The Variation of the P. D. of the Electric Arc with Current, Thickness of Carbon, and Distance Apart."

REPORTS OF COMPANIES.

THE NIAGARA POWER COMPANY.

THE stockholders of the Niagara Power Company held their annual meeting at Niagara Falls on June 2, and elected the following directors for the ensuing year: C. B. Gaskell, Benjamin Flagler, W. C. Ely, Peter A. Porter, De Lancey Rankine, A. J. Porter, L. W. Pettibone, F. A. Dudley of Niagara Falls, and Dr. Coleman Sellers of Philadelphia. The Board elected the following officers: President and chief engineer, Dr. Coleman Sellers; vice-president, Benjamin Flagler; treasurer, De Lancey Rankine; secretary, James S. Milner. Dr. Coleman Sellers will move to Niagara Falls from Philadelphia and remain until the completion of the central power station. The annual meeting of the Cataract Construction Company will take place at Jersey City on June 8.

PROF. REGINALD A. FESSENDEN has resigned as professor of electrical engineering at Purdue University, in order to take charge of the new course in electrical engineering which the Western University of Pennsylvania has decided to introduce.

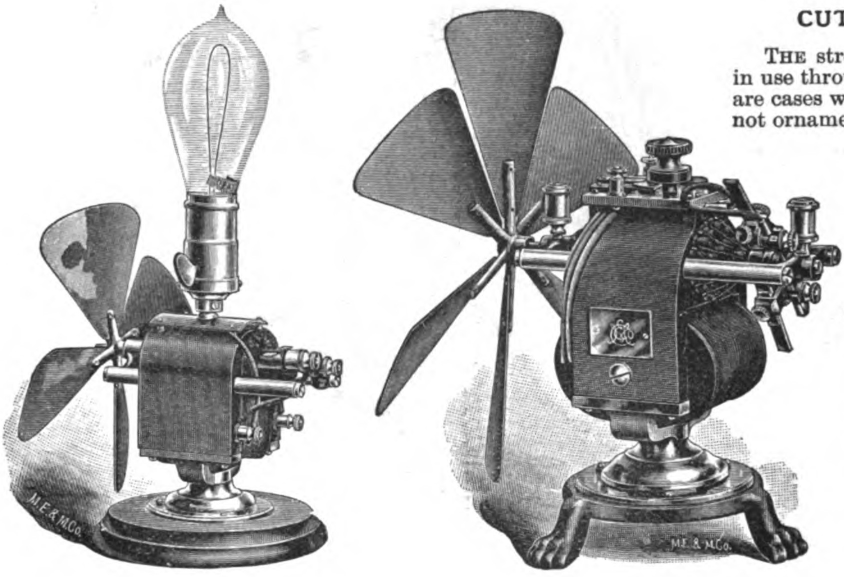
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE MENOMINEE FAN OUTFITS.

In our last issue brief mention was made of the new types of fan outfits now being placed upon the market by the Menominee Electrical and Mechanical Company of Menominee, Mich. We are now able to illustrate these neat arrangements. The accompanying engraving, Fig. 1, shows the No. 1 fan outfit, which is nickel-plated and highly finished, and the speed of which can be changed by employing lamps with different voltages. The little motor carries a 7½ inch fan.

The No. 2 outfit, shown in Fig. 2 is of larger size than the one just illustrated, being intended to develop ¼ h. p. It is finished in nickel and handsomely oxidized copper, and is designed for 110-volt circuits. A neat and ingenious switch allows operating it at three speeds, the rheostat being placed underneath the base.


M.E.&M.Co.
M.E.&M.Co.

Figs. 1 and 2.—The Menominee Fan Outfits.

Besides these motors the company also manufacture switches, annunciators, etc., of a high grade.

SYLVESTER P. DENISON'S "MODEL WORK."

A very complete plant for turning out experimental and model work has been carried on for some time past in the Cornell Building, 148 Centre street, New York city, by Mr. Sylvester P. Denison, whose very ingenious autographic telegraph system is familiar to the electrical public. Mr. Denison started out on this line in order to make his own experimental apparatus, which needed fine adjustment; and his efforts proved so satisfactory to himself and those who saw the instruments that he was asked to undertake other work for inventors. He has already built up an excellent connection, and being himself a most ingenious young engineer with fine touch and sense of proportion, his advice and practical help are well worth having. The range of his work is also curiously large. At one end of the line he has been engaged on the finest of delicate instruments, and, at the other end, he has been working for Mr. John Jacob Astor, on the road dusting and cleaning machine which that versatile Crœsus uses on his property at Rhinebeck, and is now exhibiting at the World's Fair. An acquaintance of many years' standing enables us to speak highly of Mr. Denison's care and patience and the thoroughness of his personal attention to work he may have in hand.

Electric Selector & Signal Co.—The following Board of Directors has been elected for the Electric Selector & Signal Company, of 45 Broadway, New York: Jennings S. Cox, John Dougherty, James Brown Potter, Charles F. Homer, James M. Townsend, Jr., Wm. E. Tillinghast, Thomas Sturgis, Wm. C. Lane, F. P. Voorhees, C. P. Mackie. The officers are: Thomas Sturgis, President; Wm. C. Lane, 1st Vice-President; C. P. Mackie, 2d Vice-President and General Manager; F. P. Voorhees, Treasurer; James Brown Potter, Secretary; S. S. Bogart, General Agent.

PHILADELPHIA ENGINEERING WORKS, LIMITED.

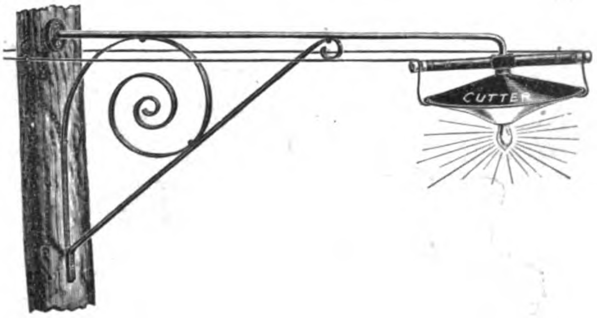
One of the most interesting and comprehensive catalogues which we have thus far come across, is that of the Philadelphia Engineering Works, Limited, whose works are situated at the corner of Mifflin street, east of Front street, Philadelphia.

It is designed especially for the information of furnace men and has been compiled with the object of enabling them to determine the relative cost of raw material used in blast furnaces, the quantity of carbon to be burnt in the production of a ton of iron with given ores; the quantity of lime-stone to be used, and other tables and data which furnace-men require daily. The numerous excellent engravings show with great clearness the various types of blast furnaces, fire brick hot blast stoves, blowing engines and numerous other details which go to make up the complete parts of the furnace plant.

This company also builds engines of high speed for electric lighting, one of their most recent constructions being a high speed condensing Corliss engine for the Hudson Electric Light and Power Company, of Hoboken, N. J. This engine has cylinders 20 x 30 inches in diameter with a stroke of 36 inches, and makes 100 revolutions per minute. Another engine of still larger power is now in course of construction for the same company.

CUTTER'S "BOULEVARD" STREET HOOD.

The street hoods designed and built by George Cutter are now in use throughout the country and well known. However there are cases where the familiar goose-neck type of bracket arm is not ornamental enough to suit some tastes. This lack is met by his "Boulevard Street hood" here illustrated, which is already beautifying many streets in Western cities.



Cutter's "Boulevard" Street Hood.

The various details of the hood and insulating arm are worked out the same as in the now standard form of hoods made by Mr. Cutter, the departure lying in the design of the supporting bracket, which is as strong and well-braced as it is neat. The maker is exploiting this new appliance from his headquarters at the Rookery, Chicago.

J. W. PARKER & COMPANY.

J. W. Parker & Company, agents for the Ball Engine Company of Erie, Pa., have during the last ten days sold the following improved Ball engines: Strawbridge & Clothier, of Philadelphia, Pa., one 16-inch by 16-inch = 150 h. p.; Leach Carpet Cleaning Company, Philadelphia, Pa., one 10-inch by 12-inch = 60 h. p.; Lehigh Coal & Navigation Company, Lansford, Pa., one 13-inch by 12-inch = 100 h. p., being the second engine of this size inside of one month; Jonas Long's Sons, Wilkesbarre, Pa., one 13-inch by 12-inch = 100 h. p., one 12-inch by 12-inch = 80 h. p.

They have during this time also sold three No. 4, 8 h. p. Case automatic pedestal engines, made by the Case Engine Company of New Britain, Conn., for direct-coupled marine dynamos. As will be seen, J. W. Parker & Company find business quite good.

CENTRAL ELECTRIC COMPANY.

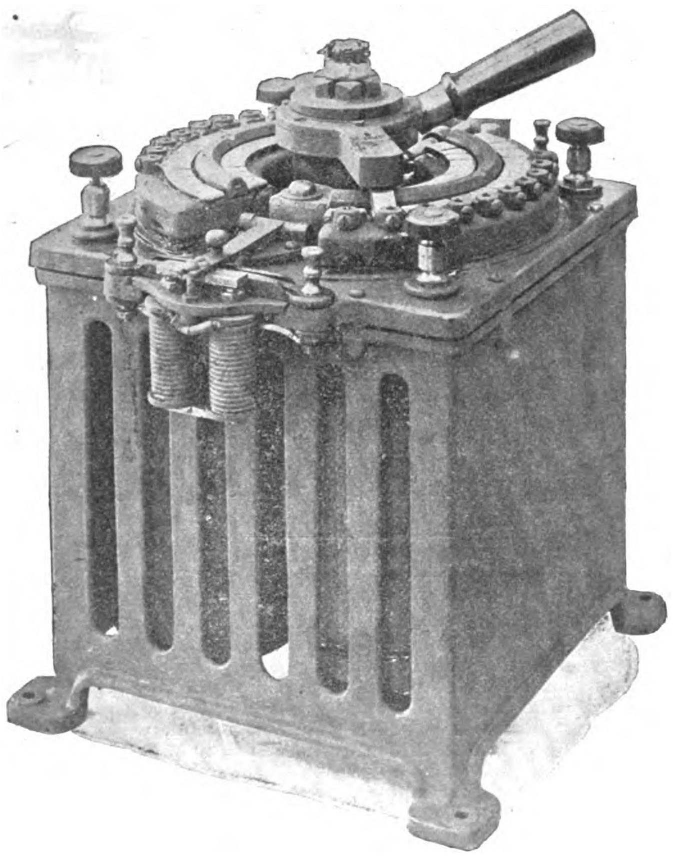
The Central Electric Company are getting in large consignments of Okonite, and are filling their orders promptly. The sales for the last month have been enormous, and the factory has had more than it could do to keep up with the demand. By increasing its facilities adding new machinery, and working over time, they have been able to get abreast of the demand.

The Central Electric Company report having a run on fan motors. The Lundell motor made by the Interior Conduit and Insulation Company, which the Central handles, is considered by them the most compact and noiseless machine to keep cool with, and a big stock is carried, customers being supplied promptly.

GENERAL ELECTRIC CO.'S AUTOMATIC SAFETY SWITCH AND RHEOSTAT.

THE rapid increase in the number of stationary motors used on railway and power circuits has led to a demand for a satisfactory automatic switch for the protection of the motor. It frequently happens on circuits where the load is variable, that the circuit is opened at the station by the circuit breakers. The circuit is always closed as soon as possible, and unless the rheostat or main switch of the motor has meanwhile been opened, the current is turned on to the motor when no resistance is in its armature circuit. In such a case a very large current flows through the armature and does damage by blowing fuses, flashing around the commutator, and, in many cases, burning out the armature. For the protection of motors, under such circumstances, the General Electric Company has devised an automatic safety switch and rheostat, which takes the place of the ordinary double-pole switch and starting rheostat, and acts as an automatic circuit breaker to protect the motor from injury due to abnormal condition of load or power supply.

The rheostat proper consists of resistance wire wound upon spools of incombustible material, which are fastened to the back of the switch base. The latter is supported by the iron box which encloses the spools. On the front of the switch base are mounted the switch contacts, the switch arm, and the automatic releasing mechanism. The switch shown in the accompanying engraving, is made up of two segments of a metal ring to which the line wires are connected. Two sets of resistance points are arranged on arcs of a circle, just outside of, and concentric with, the line rings, and a switch arm, carrying a brush at each end, which makes connection between the line rings and the resistance points on the same side of the switch arm. A spiral spring tends to return the switch arm to the OFF position, and it can be left on the ON position only when the motor is running under normal conditions. When the arm is in the OFF position, both sides of the line are open, and no current can enter the motor.



GENERAL ELECTRIC CO.'S AUTOMATIC SAFETY SWITCH AND RHEOSTAT.

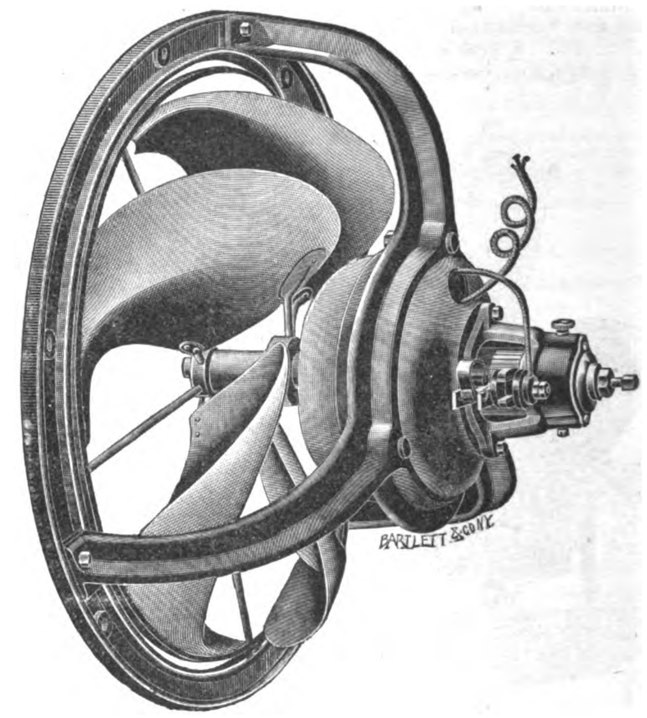
Two electromagnets govern the automatic action of the switch. One of these, known as the "detent magnet," is connected in series with the field coils of the motor and governs a detent pin, which holds the switch arm in the ON position after starting the motor, so long as the field current is maintained in the magnet. The other magnet, called the "relay magnet," is in the main circuit, and controls an armature, which, when attracted, short-circuits the detent magnet.

In case the circuit is opened for an appreciable length of time the current in the detent magnet ceases, and the switch arm, being released, flies round to the OFF position. If the field circuit of the motor is broken, the switch arm is released, and the motor is shut down. The switch also acts automatically to shut down the motor in case of dangerous overload. The armature of the relay magnet is so adjusted that when the current increases beyond the safe load of the motor, it is attracted, and the motor is shut down by short circuiting the detent magnet.

By connecting push buttons to wires running from the detent magnet, the motor may be shut down from any desired part of the building. This is a very valuable feature, and it furnishes a means of stopping the machinery promptly in case of accident.

THE LUNDELL EXHAUST FAN OUTFIT.

WE herewith illustrate a new outfit which is a combination of an ordinary exhaust fan directly coupled to a slow speed Lundell motor. The absence of belting and the absolute noiselessness of the outfit are particularly noticeable. An exposition of the adaptability of the outfit for certain places is found in the installation in the restaurant of Busse & Simoni, Delmonico's old place in New street. Guests sitting directly underneath the fan do not notice that it is running. The location of the fan is novel, and it serves a double purpose. It exhausts the air from both kitchen and restaurant and gives comfort to guests and cooks alike. This ventilating outfit is adapted for all places and is a sure means of keeping the air in a pure and wholesome condition. The Lundell exhaust fan outfit is placed on the market by the Interior Conduit and Insulation Company.



LUNDELL EXHAUST FAN OUTFIT.

NEW YORK ELECTRICAL REPAIR CO.

THE NEW YORK ELECTRICAL REPAIR CO., 465 Greenwich street, has recently been organized for the purpose of carrying out repairs on all types of dynamos, motors, electric apparatus, steam engines, etc., making a specialty of marine work. The work of the company is done under the personal supervision of Mr. A. K. Warren, late superintendent of the repair shop of the Edison General Electric Co., and any work entrusted to the company will receive thorough care and prompt execution.

THE TELEPHONE AT LIVERPOOL.

THE largest telephone switchroom in the United Kingdom, and one of the largest in Europe, is that at Liverpool, where the National Telephone Company have just completed a new one. There are worked from the Liverpool centre 9,600 miles of wire, of which more than 7,000 are exchange and private wires. In 1883 the mileage of wires in Liverpool was only 463 miles; in in February last it was 7,019. From the last published statistics it appears that the number of "calls" in the Liverpool centre is 42,800 per day.

SOUTHERN ELECTRIC CO., OF BALTIMORE, MD.

We have before us the illustrated catalogue and price list of this company which embraces no less than 340 pages of large octavo size. It would be difficult to find a single article or apparatus employed in electric applications at the present day which is not here illustrated or catalogued. The descriptions of the apparatus are very clear, and together with the illustrations give the purchaser an excellent idea of the peculiar merits of each individual apparatus. The catalogue also contains numerous tables of gauges, tables for calculating size of wires for lighting and motor distribution, the carrying capacity of wires, dimensions and resistance of copper wire, etc., which will prove of value to all engaged in installation work. The book, in fact, is a complete compendium for the user of telephones, telegraph, electric light, power, and railway apparatus.

The Southern Electric Co.'s offices are situated in the Hoen Building, 201 and 203 North street, Baltimore, Md.

NEW ENGLAND NOTES.

The Elektron Manufacturing Company, are experiencing a very lively demand for their improved electric elevators; and for the convenience of customers in that vicinity, they have recently opened an office at 103 Milk street, Boston, and, as already noted, have stationed there Mr. E. Marshall, as manager of the elevator department, and Mr. F. B. Corey, as manager of the electrical department. These two gentlemen are both experts in their particular departments and will handle successfully any business that may come their way. Mr. Marshall has had a long experience in the elevator business in connection with the Otis and Graves hydraulic and power apparatus. The Boston office has recently installed electric elevators for Messrs. Curtis & Bolster, 2304 Washington street, Boston, and Frank Ferdinand, 2280 Washington street, Boston. The main office of the Elektron Company at Springfield, has recently sold electric elevators to the new Masonic Hall, Springfield, Mass., the finest building in the city; Brown, Thompson & Co., dry goods store, Hartford; W. H. King & Son, paper dealers, Springfield. The latter is the second order from these parties.

The American Railroad Improvement Company has opened offices at Room 15, 95 Milk street, Boston. The company has been formed with a capital stock of $1,000,000, of which $400,000 is preferred, at 7 per cent. The president is Edmund Davis; vice president, H. H. Ashley; secretary, O. B. Goldsmith; treasurer and general manager, G. A. Beatey, whose engineering business and railroad signal, car ventilator, etc., the company has taken over and will push. One of the directors is T. McCoubray.

The Berlin Iron Bridge Company, of East Berlin, Conn., will build a new machine shop for the Fuller Iron Works, at Providence, R. I. The peculiarity of this shop will be that the sides are entirely of glass, under the patents lately granted the Berlin Company for this construction. This building will be 90 feet in width and 210 feet in length.

NEW YORK NOTES.

The Interior Conduit and Insulation Company, 44 Broad street, have recently made another interesting and novel departure by offering to furnish architects with wiring specifications, or advice on same, free of charge. There can be no question that this expert assistance will be very gladly welcomed in a great many quarters, as architects cannot be expected to be thoroughly posted on such matters, unless they have made a study of them; and even then points arise that only those familiar with the art can settle. We believe that this step will lead to a great improvement generally in wiring plans and work, and to the advantage of the skilled and competent electrical engineer or contractor, who never objects to having his work scanned and tested.

Mr. John C. Dolph has been appointed general eastern agent for the Eureka Tempered Copper Company, of North East, Pa., and will have charge of their growing interests in this section. Mr. Dolph has a large acquaintance with the electrical trade and field, and was at one time connected with the Short Electric Railway Company. He finds a very general appreciation of Eureka tempered copper and believes that it is driving even the cheapest of the old alloys out of use, as the public now wants only the best material in motors, dynamos, etc.

The Direct U. S. Company, informs us that it has opened an important branch station for the accommodation and convenience of cablers in London at 50 Old Broad st., Winchester House, directly connected with the cables of the company.

Mr. Gisbert Kapp, the distinguished English electrical engineer and designer, returned to London last week after a glance at the World's Fair and a brief trip around the country.

The Electric Secret Service Company, of Buffalo, 128 Erie County Savings Bank Building, will not only handle the Johnson apparatus for temperature regulation, but will represent the Elektron Manufacturing Company, and the Siemens & Halske machinery and other specialties for which Mr. C. D. Shain is agent. They will work principally in the western part of New York State. They will show a line of Elektron Perret motors at their headquarters.

Mr. Harold Binney has removed his offices to the Potter Building, 38 Park Row, where he will continue his practice as a solicitor and expert and as attorney and counselor-at-law in all patent and copyright matters. He takes over also the law practice of Mr. Gilbert M. Plympton, with whom he has been associated and who is joining Redmond & Kerr, at 41 Wall street. Mr. Binney now has a large and valuable connection.

Mr. H. M. Haines, the representative of the Pennsylvania Road, who has accompanied so many of the National Electric Light Association special trains, has become treasurer of the American Traveler and Tourist Company, 849 Broadway, which conducts a general railroad, steamship and steamboat business. Mr. Haines is readier than ever to help his innumerable electrical friends secure special traveling facilities of all kinds.

Mr. Chas. E. Chapin, 136 Liberty street, has been appointed selling agent for Central and Eastern States for the "Wave" pinion for electric cars. This pinion wears remarkably well. Its peculiarity consists in the use of laminæ of steel and a non-resonant material arranged not quite at right angles to the shaft; whence results the "wave" motion, equalizing and reducing wear.

Mr. Harris W. Baker, who has been connected with the Elektron Manufacturing Co. at Springfield, Mass., has come to New York to represent the company here as New York manager. He will have his headquarters for the present at the old offices in Liberty street. The company, he informs us, are now ready to push their new electric elevators in this vicinity.

H. B. Hollins & Company, the bankers, Wall and Broad street, have issued a very interesting bulletin with regard to the miscellaneous list of securities they are handling. It includes the Brooklyn, Columbus, Boston North Shore, and Worcester electric street railway enterprises, about which a variety of information is given in detail. The circular is useful for the data it contains.

The Tuerk Water Meter Company of Fulton, N. Y., have issued a neat catalogue illustrative and descriptive of their ventilating fans and attachments, showing a great variety of ingenious details and useful applications.

Mr. Albert E. Plowman is actively representing the electrical interests of Porter Bros. & Co., of Worth and Thomas streets, who make detail insulating parts for sockets, switches, pushes, etc.

Mr. G. H. Stockbridge, the electrical expert and patent solicitor, has removed his offices to 39 Cortlandt street.

PHILADELPHIA NOTES.

A La Roche Hotel Plant. McClure Bros., of Wheeling, W. Va., have recently closed contracts with the La Roche Electric Company of Philadelphia, and with Russell & Co., of Massillon, Ohio, for the completion and placing in operation of a fine new electric light plant which is to light the McClure House hereafter. The contract for the electrical apparatus was taken for the La Roche Company by Mr. George Loutey, their agent, and calls for two 300-light compound wound, latest improved dynamos. The complete steam plant will be put in by Russell & Co., the contract being taken by Mr. F. G. Borden, Pittsburgh agent of the company. It will consist of two engines of 35 h. p. The boiler will be 60 inches in diam., 14 feet in length, and with a capacity of 70 h. p., complete with pump, heater and injector. The construction of the entire plant is being superintended by Mr. J. W. Crosby, of the engineering firm of Hix, Crosby & Co., Baltimore.

Queen & Co., Incorporated, report a large stock of "Magnetic-Vane" ammeters and voltmeters which they can ship promptly and are pushing with great vigor. These instruments combine qualities highly essential for switchboard use and which render them specially valuable for isolated plants. A number have been supplied to exhibiting companies for installation at the World's Fair, and the makers have a handsome collection in their own display. The "Acme" portable testing set described in detail last week, is sure to become a favorite instrument for general testing. Queen & Co. have already received orders for more than 20 sets. Circulars No. 420 and 445, describing these specialties, can be had for the asking.

Franklin's Legacy. It is proposed to utilize Franklin's legacy, which now amounts to over $100,000 in Philadelphia, in founding a chair in electricity at the High School. The question will come up in the Fall. The idea is excellent and should be carried out.

Queen & Co., Incorporated, Philadelphia, have a new specialty in the "Acme" portable testing set, described last week in these columns, which can hardly fail to meet with great favor. It is remarkably compact and complete, all necessary parts including the battery being contained in one small and handsomely finished mahogany case that weighs only six pounds. The set is particularly well adapted to outside testing but gives equally accurate results in central stations or factories, and on shipboard. It will be extensively handled by the trade as a standard article.

CANADIAN NOTES

Mr. Charles F. Medbury has resigned his position of agent for the Montreal District of the Canadian General Electric Co. and accepted that of general sales agent for Messrs. Ahearn & Soper of Ottawa, the Canadian agents of the Westinghouse Electric Co. of Pittsburgh. In this position he will look after the sales of Westinghouse apparatus throughout Canada. Mr. Medbury has had an extensive experience with the Thomson-Houston Electric Co. in the United States, as well as with the Canadian General Electric Co. in Canada, and is exceedingly well qualified for the position he has been selected to fill.

The Montreal Electric Club held its last meeting for the season on May 29th. An instructive paper was read by Mr. H. Ritchie on "Testing Dynamos and Motors," and the secretary-treasurer afterwards presented a report, showing the club to be in a flourishing condition financially and the membership to be increasing very satisfactorily. The meeting then adjourned to meet at the call of the president next September.

The Royal Electric Co. passed a resolution on June 1 to offer 2,500 shares out of 7,500 now unissued, for subscription at par, in order to provide funds for taking care of the company's rapidly increasing business. It is now supplying 1,273 arc lights, 31,650 incandescents and motive power to 53 establishments at a gross annual revenue of $360,000.

The Montreal Park and Island Railway Co. and the Corriveau-Williams Syndicate have amalgamated. The Park and Island Co. has a broad charter as to the construction of elevated or surface railways on the island of Montreal, and now that the privileges and franchises of both are united, it will be able to construct an electric railway system which can be extended over the island wherever the traffic warrants. It has an authorized capital of $1,000,000, and includes among its shareholders American and Canadian capitalists. An electric surface line is to be constructed at once from Montreal across the island to Sault aux Recollets and is to be ready this fall.

The Montreal Street Railway Company are equipping their new power house with Westinghouse multipolar generators supplied by the Canadian agents, Ahearn & Soper, Ottawa.

Mr. A. W. Congdon, formerly engineering representative of the Canadian General Electric Co. for the Montreal district, has been appointed agent of the company for that district.

WESTERN NOTES.

Peoria, Ill.—It has been for some time an open secret that the affairs of the Fort Clark Street Car Company were in a rather unsatisfactory shape, and that the expenses exceeded the receipts so much that the interest on the bonded indebtedness could not be kept up. The General Electric Company is the principal creditor, it having furnished the equipment. The old board of directors have resigned and the new board has been duly elected. It consists of John H. Hall, W. T. Whiting and Frank O. Cunningham, all of this city, and F. W. Horne, J. S. Cummins and G. H. Atkins, all of Chicago. Capt. John H. Hall retains the presidency, with B. K. Otis of this city as secretary in place of Willis Hall. This virtually amounts to the General Electric Company having control of the road.

Diamond Dust.—The Ansonia Electric Company continue to receive flattering testimonials of the superior quality of their famous Diamond carbon battery. A letter just received by this company in regard to other matters contains the following, and being from one of the largest consumers of batteries in the country, it is very gratifying. "As you very well know, we have quite a demand from physicians for the Diamond carbon battery; it has never disappointed us and we hold it among the most reliable, if not the most reliable cell, we have."

Mr. J. Holt Gates, who for some time has held the position of general sales agent for the Siemens-Halske Co. of America, has resigned the above position and has identified himself with the Waddell-Entz Co. of New York and Bridgeport, Conn. Mr. Gates will represent the above company in the capacity of Western Manager with headquarters at Chicago. His present office address is 1,122 Monadnock; permanent offices, 1,139 and 1,140, will be taken possession of as soon as ready.

The Electric Appliance Company are offering something new in the incandescent lamp business, namely, a lamp of lower candle-power and a lamp of higher candle-power than have been produced up to date. The first is their 6 c. p. lamp made to fit any regular socket and burn on regular circuits with the filament at the incandescence of an ordinary 16 c. p. lamp. The improvement in the other direction is in an incandescent lamp up to 1,000 c. p. and of a very high efficiency. The Electric Appliance Company hope very shortly to have one of these thousand-candle-power lamps burning in their World's Fair exhibit. These are of course Packard lamps manufactured by the New York & Ohio Company, for whom the Electric Appliance Company are Western agents. From the interest that is being manifested in the new lamps, the manufacturers have reason to believe that they will soon be in extensive use.

The J. H. & D. Lake Co., manufacturers of all kinds of friction clutch pulleys, having outgrown their old quarters at Hornellsville, N. Y., have recently completed and removed to their handsome new offices and foundry at Massillon, Ohio, where, with enlarged facilities, they are prepared to meet the growing demand of their business. An interesting feature regarding the rapid growth of the Lake Company is the fact that it came almost exclusively from advertising, for with the exception of a limited amount of traveling, they have had no representative out on the road, except their card in the various class journals.

The Hill Clutch Works of Cleveland, O., have recently obtained contracts from the following companies, for shafting, clutch pulleys, etc.: N. W. Gokey & Son, Jamestown, N. Y.; Aurora Street Railway Company, Aurora, Ill.; Star Electric Company, Dubuque, Ia.; Hartman & Markward, Warrensburg, Mo.; Marshall Electric Light and Power Company, Marshall, Mo.; Mexico Electric Light Company, Mexico, Mo.; Carbondale Traction Company, Carbondale, Pa.; M. C. Bullock Manufacturing Company, Chicago, Ill.

The Iowa Electric & Construction Company, has recently been formed at Des Moines, Ia., with a capital stock of $100,000 and with headquarters and show-rooms in the Iliad Block, that city. E. C. Spinney is president; E. G. Pratt, vice-president; J. A. Innes, secretary, and W. Bowen, treasurer. It will do a miscellaneous electrical supply and construction business, and will also undertake electric light and electric railway work.

Capt. W. L. Candee, of the Okonite Company, Limited, is spending a few days in the city looking after his exhibit at the World's Fair. The Okonite Company have been very busy, and have been delayed in this particular line, but the work is now well under way, and they promise to make a very creditable showing.

The Buckeye Electric Company in reply to an inquiry say that the Summer season has brought no diminution in the demand for lamps, but that on the contrary the market shows a large absorptive capacity for Buckeye lamps.

Marion, Ind.—The Marion Street Railway Company have begun work on a line of road to Gas City via the Soldier's Home. The Ansonia Electric Company's new line of overhead fixtures will be used along the whole road.

The Central Electric Company are furnishing the *Sentinel* Building, of Milwaukee, complete with conduit and fittings, made by the Interior Conduit and Insulation Company, for whom they are the Western agents.

The Wirt Lamp Regulating Switch, which serves to graduate incandescent lamps to any desired candle-power is being introduced and pushed by the Ansonia Electric Co., the sole manufacturers.

The Ansonia Electric Co. report an enormous sale in the last month of Habirshaw wire. They also closed a contract last week for upwards of forty miles of Shield Brand wire for lighting and power work.

The Ford-Washburn Storelectro Co., Cleveland, O., report that hot weather is a good offset to general dullness and that they have been doing a tremendous business in fan motors and other motor lines.

SOUTHERN NOTES.

The Southern Electrical Manufacturing & Supply Company, Ltd., of New Orleans, has sent us a list of plants it has installed. The showing is a fine one, and includes mills, plantations, breweries, steamers, refineries, etc., making a total of 13,773 lights.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XV. JUNE 28, 1893. No. 269.

OTIS ELEVATORS CONTROLLED BY THE LEONARD METHOD, IN THE AMERICAN THEATRE.

THE new American Theatre situated at the corner of Forty-second street and Eighth avenue, in this city, contains perhaps as complete an electrical equipment as can be found in any theatre. The generating plant is situated in the cellar of the wing facing Eighth avenue, and occupies a space 79 feet long by 17 feet wide. Within this space are contained three Edison 60 k. w. dynamos, each belted directly to a 13 x 12-inch Armington & Sims high-speed engine, the dynamos revolving at 700 revolutions per minute, and the engines at 250. These dynamos are used for lighting and are controlled by a switchboard embodying the latest controlling devices.

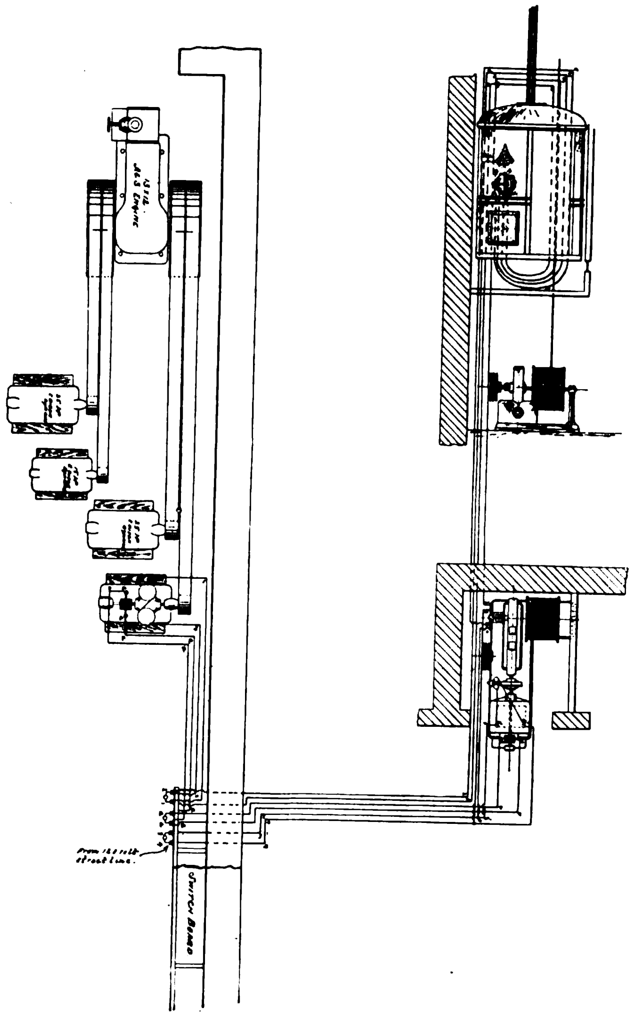


FIG. 1.—DIAGRAM SHOWING CONNECTIONS OF OTIS ELEVATORS CONTROLLED BY THE LEONARD SYSTEM.

Special features of the electrical plant, however, are the electric elevators installed by Messrs. Otis Brothers & Co., and controlled by the method devised by Mr. H. Ward Leonard. These elevators are five in number, two running from the lobby to the roof garden and balcony, one to the gallery, one for the apartment house and one to the lodge rooms connected with the theatre building.

Each of these elevators is operated by its own separate generator of 25 k. w. capacity, driven by a 13 x 12-inch high-speed Armington & Sims engine arranged as shown in the diagram Fig. 1. Each elevator is driven by a 28 h. p. Eickemeyer motor operating the winding drum through the medium of worm gears, the very compact combination being shown in Fig. 2.

Our readers will remember that the Leonard system of control for electric motors differs from the usual methods in that regulation is effected in the electric generator supplying the motor and not in the motor itself. In the ordinary method in present use, the generator produces a constant pressure and is not regulated when a change of speed or of direction of rotation of the motor is desired ; but all the regulation is effected at the motor by reversing switches and rheostats in the path of the current supplied to the motor. In the Leonard system, when it is desired to reverse the direction of the motor, the magnetism, and consequently, the current of the generator, is reversed. Similarly, when a lower pressure is desired on the motor, in order to go slower, the pressure produced by the generator is reduced, instead of keeping the pressure of the generator at its full amount and reducing the pressure supplied to the motor by means of a rheostat.

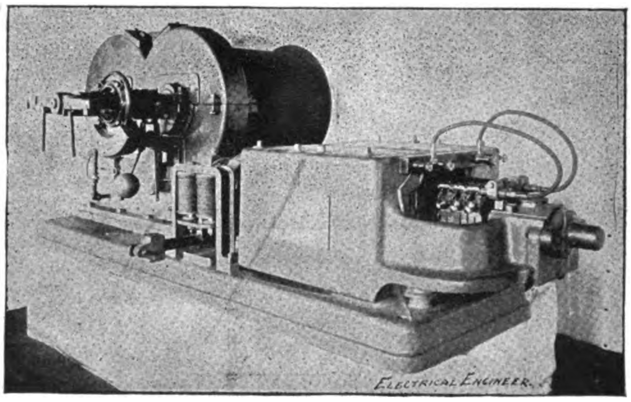


FIG. 2.—OTIS ELEVATOR DRIVEN BY EICKEMEYER MOTOR.

The diagram, Fig. 1, shows the electrical connections between the generators and the elevator motors. As will be seen, the armature of the elevator motor is in permanent electrical connection with the armature of the generator, while its field is separately excited from the street mains or lighting circuit of the isolated plant. The field of the generator is also separately excited from the same source. Under these conditions of constant field in the motor, the same load will be lifted at all possible speeds with the same quantity of current, but a slow speed will mean a weak field and a low voltage of the generator, and the work of the engine driving it will decrease in proportion to the speed. As the generator is wound for maximum speed and high voltage it will not spark since with a commutator arranged for high voltage the number of volts per commutator bar are very small when used for low voltage.

The current for the separate excitation starts at the switchboard at 3 and from there goes to a point 3 half way up the elevator shaft; thence through a flexible cable up to the terminal 3 of the reversing switch in the car. The outgoing line starts from the terminal 4 of the reversing switch through the flexible cable to 4 half way up the well hole and thence back to the switchboard 4. The connection wires, being called upon to carry a current not exceeding two amperes, are only of No. 16 B. & S. gauge.

The switch on the car, shown in Fig. 2, controls the field of the generator by circuits 1 and 2. Wires 3 and 4 run through the switch devices operated by the automatic stop motion, which stops the elevator independently of the operator at the upper and lower landings by opening the circuit. A branch of 3 and 4 supplies the constant excitation to the elevator motor and to the emergency brake. The current in this branch when on, keeps the brake off by means of the solenoid magnet shown in Fig. 2, but, in case of accident to the circuit, drops the weight and holds the load. While the field of the motor is regularly excited the load is controlled without brake by being held electrically by the reaction of the armature and field current, and any motion of the motor after the current generator in the generator dies out will convert the motor into a generator and send a strong current through the permanently closed armature circuit and thus stop the elevator.

The elevators can be raised, lowered, reversed and stopped without brake in the most perfect manner by merely altering the field of their generators. A small reversing switch in the car with proper Carpenter enamel rheostats enables the operator in the car to start with remarkable smoothness by means of a very low pressure besides enabling him to run without wasteful resistances in the armature circuit from slowest to full speed.

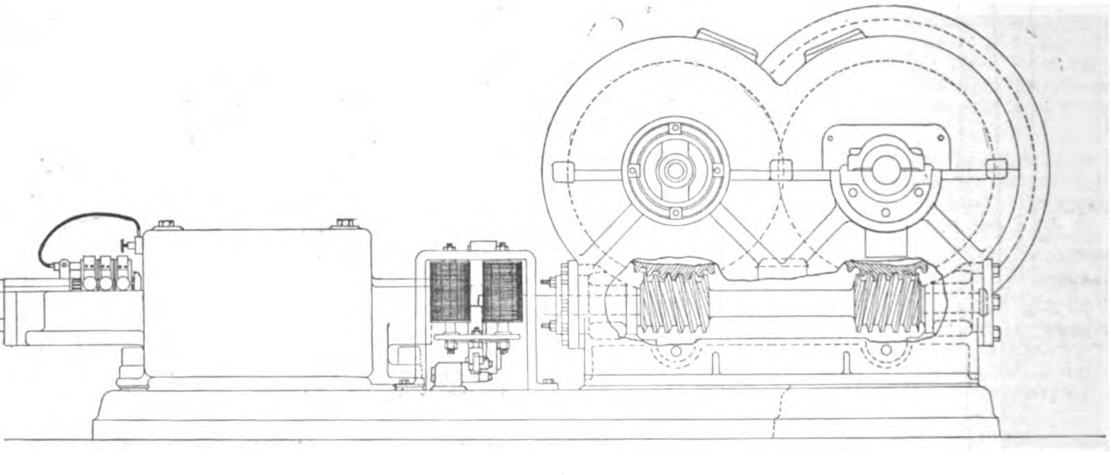


FIG. 3.—OTIS ELECTRIC ELEVATOR WITH DOUBLE SCREW AND WORM WHEEL.

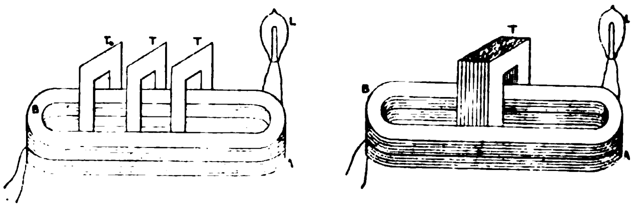
The hoisting gear proper, which is shown in Fig. 3, is of the most improved mechanical construction, having a double screw, one right hand and one left hand, with the wheels meshing together so as to divide the work on the two gears and thus do away with the end thrust. This screw and gear combination ensures perfect motion with the least loss by friction and backlash.

The elevators and electric plant were selected for the American Theatre by the architect, Mr. C. C. Haight, and were installed under the supervision of Lieutenant Blandin, of the Naval Equipment Bureau, by the New York Electric Equipment Company.

A CURIOUS TRANSFORMER EXPERIMENT.[1]

AN effect not hitherto described was noted while making some experiments with transformer coils, an effect showing that the distribution of the iron inside of the coils of a transformer has a considerable influence on the induction; besides showing this effect, the experiments are instructive and are worth describing, so that they can be repeated.

The coils, A and B, primary and secondary respectively, are made up of No. 16 B. W. G. wire, about 200 turns; the coils are 12 inches long inside and 2½ inches wide; the secondary is laid on top of the primary, into which is sent an ordinary alternating current of 7 to 8 amperes with a frequency of 100. To the ends of the secondary a 12-volt incandescent lamp is fixed. Under these conditions the lamp is heated only to a very dull red; if now, as in Fig 1, we insert iron stampings, T, of U-shape one by one into the coils, the lamp, of course, brightens up as each stamping is inserted, thus showing the effect of adding iron in the circuit. It will be also observed that the iron stampings tend to fly apart, and stand as far from each other as possible, as shown in Fig. 1, and if we press them together as in Fig. 2, and then let them go free, they will immediately fly apart. This is easily understood; but it is not so easily understood why that when the lamp is burning brightly with the stampings standing free to choose their own position in the coil as in Fig. 1, and then when we forcibly press the stampings together as in Fig. 2, the lamp drops at once to a dull red, showing that the induction is much greater with the iron parted than it is with the iron compactly pressed up as in Fig. 2.



FIGS. 1 AND 2.

The iron stampings are insulated thoroughly with paper and shellac. In both experiments the amount of iron is the same in the coils, yet the mere separating of the plates of iron increases the induction, and bringing them together decreases it, and all this can be very nicely shown to a class or in a lecture room by the simple arrangement sketched. The lamp makes a splendid galvanoscope, showing the rise and fall of the induction in the coils. I shall be glad to hear of any explanations anyone may offer.

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[1] Rankin Kennedy, in London *Electrical Review.*

A considerable number of volt and ammeters are made in which this repulsion of pieces of iron inside a coil carrying a current is made the measure of the current in the coil; in these instruments this effect may play some part worthy of note if the induction is greater when the iron is parted than when close together. In the Hedgehog transformer the parting of the iron wires at the ends of the coils very greatly increases the induction through the coils. By this experiment it is found that parting the iron inside of the coils also increases the induction through them.

STATISTICS OF FIRES CAUSED BY ELECTRIC CURRENTS.

BY

E. A. Boudinot

The following interesting exhibit of the number of fires caused by electric currents and the resulting losses, in 60 cities of the United States, as compared with the total number of fires and losses from all causes, in the same cities, is the result of an inquiry recently instituted with a view to ascertain the truth regarding the danger of fires which attends the use of electricity.

A series of questions designed to elicit the facts, was addressed to the Chief Engineer of the Fire department in each city which contained more than 20,000 inhabitants at the census of 1890; reports were received from about one-half the cities coming within the scope of the inquiry, but only 60 of the reports were so complete in details as to be available for tabulation; these are included in the table given below, which presents, for each city, (1) the total number of fires from all causes, (2) the losses resulting therefrom, (3) the number of fires attributed to electric currents, and (4) the losses sustained.

The reports were tabulated as received, without alteration in any respect, except those from Washington, D. C., and Minneapolis, Minn., respectively. In the former city, one fire, which the department attributed to electricity—a gas-tank struck by lightning, loss $10,000—was omitted because of the manifest absurdity of including it in a statement such as this. The Minneapolis report gave the losses from electric light fires at $169,644.30; this was evidently a clerical error, as the total shown by the official report of the Chief Engineer was but $64,106.31, the latter sum was, therefore, taken as being correct and included in the table. The reports tabulated are from all parts of the country and for cities ranging in population from 20,000 to over a million and a half of inhabitants, five having over 400,000, five from 100,000 to 400,000, ten over 50,000 and under 100,000, twenty-six between 25,000 and 50,000, and fourteen under 25,000 and over 20,000, representing an aggregate population of more than 6,750,000.

From the totals of the table we find that there were 17,095 fires from all causes in the cities named during the year and that the losses amounted to $22,781,532.91. 203 fires, with $281,241.06 of losses, are attributed to electricity, which is thus shown to be responsible for 1.19 per cent of the fires and 1.23 per cent. of the losses, or about one fire in each 85 and less than $1.25 of each $100 of losses.

Considering merely the fires caused by electricity, we find that New York City, with 59 fires, heads the list, followed by Boston, (26), Cleveland (16), Lowell (12), Minneapolis (11), and Philadelphia (10), in the order named; the remaining cities having experienced less than 10 fires each during the year; but in average loss per fire Rockford, Ill., with five fires takes the lead, having sustained losses aggregating over $37,000, or $7,527.50 per fire, Minneapolis being second with an average of $5,827.85. Then come Boston $3,662.12, Lynn a single fire $3,000, Topeka $1,790.10, and New York $1,188.40, the last of the cities in which the loss per fire was over $500; fires in the other cities ranging from $5.62 in Cleveland to $493.50 in Memphis.

The generator capacity of electric light and power plants (central stations, isolated plants and street railways) located in these cities amounts to over 200,000,000 watts, which is the equivalent of nearly 4,000,000 16-candle-power incandescent lamps, or 285,000 horse-power.

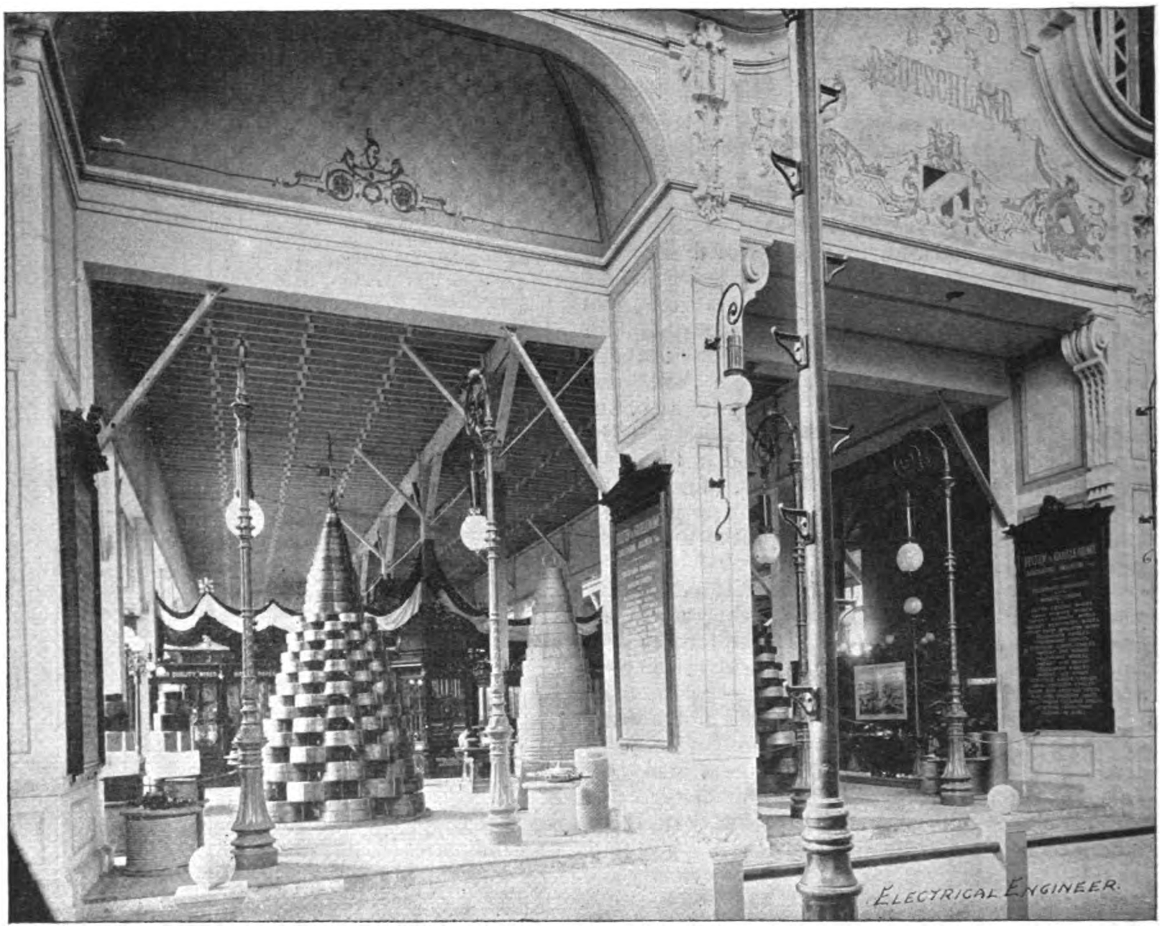
Fires Caused by Electric Currents, in 60 Cities, and Losses from Same.

Cities.	Total fires from all causes.		Fires caused by electricity.	
	No.	Losses.	No.	Losses.
Akron, Ohio	96	$26,147.18	2	$752.60
Allentown, Pa	51	44,074.45		
Auburn, N. Y.	54	38,580.00	2	250.00
Baltimore, Md	676	650,009.78	6	875.00
Binghamton, N. Y	87	48,395.93		
Boston, Mass	1,230	1,629,418.00	26	95,215.00
Cambridge, Mass	198	225,292.46	3	100.00
Chelsea, Mass	83	32,543.69		
Chester, Pa	45	5,440.00		
Cleveland, Ohio	982	1,076,260.00	16	90.00
Cohoes, N. Y	41	16,814.00		
Council Bluffs, Iowa	74	35,000.00		
Covington, Ky	106	27,760.00		
Dallas, Texas	250	888,899.63	1	25.00
Dayton, Ohio	270	21,372.39		
Detroit, Mich	590	630,976.00	9	932.00
Duluth, Minn	83	147,155.00		
Elmira, N. Y	90	180,947.52		
Erie, Pa	90	51,015.00		
Fitchburg, Mass	45	20,276.25		
Jackson, Mich	107	58,282.96	1	250.00
Johnstown, Pa	17	63,200.00		
Kansas City, Kans	154	48,985.00	6	820.00
Kansas City, Mo	560	340,588.50	3	35.00
Lancaster, Pa	60	125,000.00		
Lawrence, Mass	87	12,578.26		
Lewiston, Me	37	9,761.06		
Lowell, Mass	299	50,392.50	12	135.00
Lynn, Mass	145	54,963.64	1	3,000.00
Malden, Mass	63	11,796.85		
Manchester, N. H	71	59,542.68		
Memphis, Tenn	275	370,145.70	2	987.00
Meriden, Conn	48	25,184.00		
Minneapolis, Minn	682	1,156,069.00	11	64,106.31
Newburgh, N. Y.	1	250.00		
New Haven, Ct.	240	73,254.08	2	87.55
Newton, Mass	86	10,000.00		
New York, N. Y	3,938	6,959,650.00	59	70,116.00
Paterson, N. J	200	292,278.00	5	220.00
Pawtucket, R. I	69	75,863.95		
Petersburg, Va	37	26,985.59		
Philadelphia, Pa	1,360	2,657,285.00	10	2,617
Reading, Pa	57	150,000.00		
Rockford, Ill	112	87,785.02	5	37,637.50
Sacramento, Cal	80	140,260.00		
Salt Lake City, Utah	115	95,820.27	2	20.00
Savannah, Ga	196	345,265.00		
Scranton, Pa	161	272,217.69	3	25.00
Seattle, Wash	136	124,872.00		
Sioux City, Iowa	113	149,367.31		
St. Louis, Mo	1,358	2,571,255.00	7	840.00
Taunton, Mass	66	21,765.54		
Topeka, Kans	148	76,330.89	1	1,790.10
Troy, N. Y	146	89,329.24		
Washington, D. C	400	162,086.00	5	800,00
Wheeling, W. Va	59	47,000.00	2	50.00
Williamsport, Pa	54	82,000.00		
Wilmington, N. C	69	22,500.00		
Yonkers, N. Y	55	40,000.00		
Youngstown, Ohio	93	85,800.00	1	15.00
Totals.	17,095	$22,781,532.91	203	$281,241.06

WORLD'S FAIR DEPARTMENT.

GERMAN WIRES AND CABLES AT THE FAIR.

One of the most complete exhibits of its class in the Electricity Building is that of Messrs. Felten & Guilleaume, of Carlswerk, Mühlheim-on-the-Rhine, Germany, the total yearly output of whose factories averages 54,000 tons. The display occupies the southwest space of the section belonging to Germany, one of the four corners formed by the intersection of the nave and transepts, and consists of wire for all imaginable purposes, electrical and otherwise, arranged in a manner quite worthy of its prominent position. The most striking objects within the enclosure are the three great pyramids, shown in the engraving. The first of these is built up of rolls of copper wire of all sizes, and weighs 26 tons. The second is of coils of wire rope decreasing in size from base to apex ; and the third, like the first, is built of smaller rolls, but of iron and steel instead of copper, and weighs 24 tons. These great masses of metal are, of course, supported on heavy foundations beneath the floor. Spools of wire rope, barbed wire, etc., and rolls of wire-netting stand at the corners, and wire mats are thrown upon the floor at the entrance gates.



German Wires and Cables at the World's Fair.

In the centre of the space is a high hexagonal cabinet standing on a table of similar shape on which are shown raw and refined gutta percha, Para rubber, rubber compound, rubber tape and sheet rubber for various purposes. The cabinet itself contains twelve panels covered with short sections of conductor and flexible cord, dynamo leads and house wires, covered with rubber, gutta percha, and other insulating compounds, and protected with braid, lead or asbestos, or all three, according to the use for which they are intended. A large number of different forms of junction boxes, house-service boxes and connection sleeves are displayed on a table near by, as are also sections of underground, armored cable for electric light and of paper insulated cable for telephone service. Two full-size distribution boxes of the kind in ordinary use in Germany are shown with their covers removed for inspection and form an interesting feature of the exhibit.

The entire rear of the space is occupied by a beautifully-built cabinet with a glass front containing hundreds of specimens of the company's cables and metal work. Here are shown rods and wires, transmission ropes and belts of iron, steel, copper and brass. Some of the ropes have outside strands of such a cross-section that when wound they form a perfectly flat surface so that the rope is truly cylindrical in form instead of having the usual corrugations due to the use of round strands. Another division of this case contains sections of large armored and lead-covered cable for high and low tension with impregnated fibre insulation. Here are also shown methods of making joints in electric lights cables, from the separated ends to the finished splice; telephone cables with paper insulation so placed on the wire as to leave a considerable air space, and thus lessen the electrostatic capacity; more telephone cable with rubber, gutta percha and fibre insulation; torpedo cables, telegraph cables and mining and marine ropes and hawsers. Among the high grade wires shown in all sizes and for all purposes is one roll five inches in diameter and one square inch in section containing 5¼ miles of wire. The exhibit is lighted at night by Sohuckert arc lamps, supported on ornamental posts of German workmanship and design.

Perhaps the most remarkable feature of all, however, is the strict order given to the company's representative to furnish no data or illustrations whatever for publication. Considering the fact that the sole reason in making an exhibit must necessarily be to give additional publicity to the article exhibited, the action of our Teutonic friends certainly seems incomprehensible. It is only equaled by that of the custodians of "Victoria House," the model English country seat on the lake front. These talented persons having furnished the building fairly well, but by no means so tastefully or elegantly as has been done with many of the other foreign government buildings, have carefully locked it up and allow no one to enter unless provided with a pass for which he must apply to somebody by mail. The two actions differ, however, in this: the latter is merely insular and characteristic, while the former strikes an unprejudiced mind as both futile and idiotic.

The exhibit itself, though, is excellent both in respect to material and of arrangement.

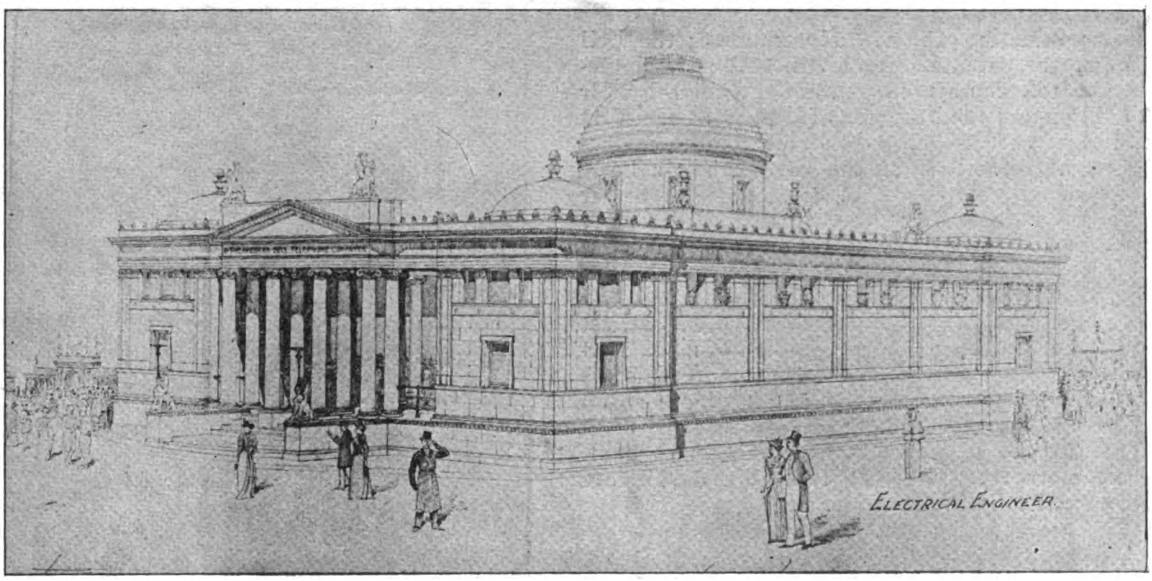
THE EXHIBIT OF THE AMERICAN BELL TELEPHONE CO.

It will be remembered that in The Electrical Engineer, of May 17, appeared a short illustrated note in regard to the beautiful temple of the American Bell Telephone Company of Massachusetts. At that time it was impossible to write a complete description of the exhibit without drawing largely on the imagination as the building was far from complete within and much of the apparatus was wanting. The extensive alterations mentioned last week, while they could not improve what was already architecturally perfect, have not marred the appearance of the building, and the added space contributes greatly to the comfort of visitors.

The temple itself, a view of which from the architect's drawings is shown on this page, is 103 feet long and 67 feet wide and stands at the south end of the Electricity Building, directly in front of the main entrance. A broad flight of steps leads up to a portico of Ionic columns beyond which is a wide atrium and at the rear of this a domed inner temple large enough to accommodate about a hundred persons. To the right and left of the atrium are peristyles of Ionic columns connecting the offices and reception rooms at the four corners of the building. The rotunda of the inner temple is 24 feet in diameter, formed by 8 Ionic columns 14 feet high, supporting an ornamental entablature and the dome. In the rear is a portico for exit similar to that in front. If the building has a fault, it is that it is so perfect, complete and satisfying in all its details that one is tempted to devote to it his whole attention, forgetting that it contains one of the most interesting collections of apparatus in the entire Department of Electricity. It is doubtful if there is a more exquisite bit of architecture within the grounds.

In the west peristyle is the operating switchboard of the Chicago Telephone Company, for its World's Fair exchange.

This is both an exhibit and a regular operating "central," simply railed off from the passage way, and it is connected with all subscribers within the grounds by metallic circuits.

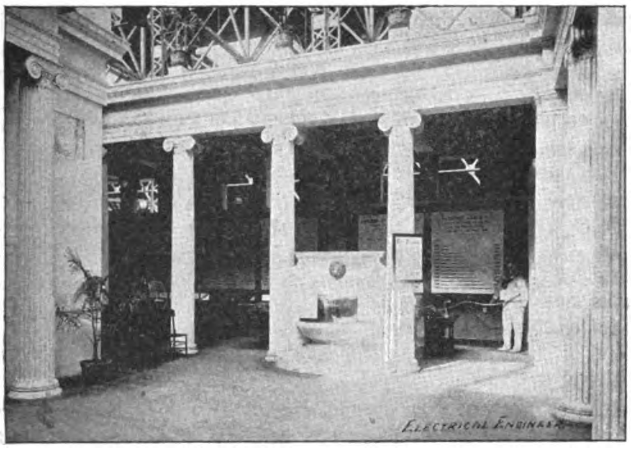


The American Bell Telephone Temple, Electricity Building.

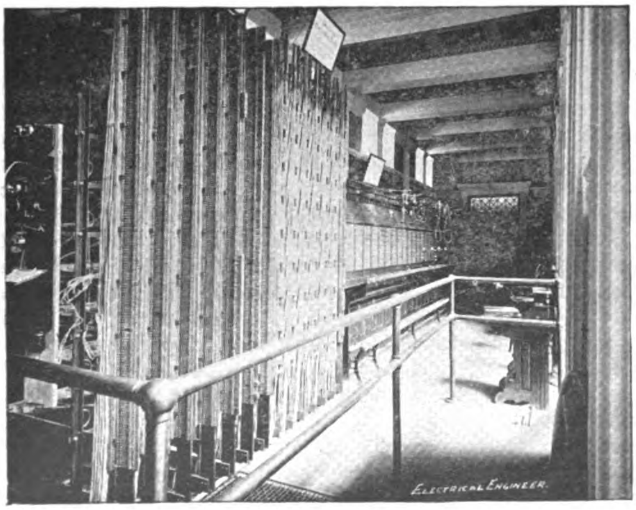
At the south end is a man-hole covered with a stout grating and brightly lighted, showing the underground cables, each containing 50 pairs of wires, entering from the conduit ducts and passing to the cable heads, whence the wires, after being separated, are led upward and again gathered into cables. Next the man-hole is the main distributing frame where connection is made with the switchboard wires, and adjoining this, the intermediate distributing frame where the subscribers' lines are connected with the annunciators. Beyond this is the switchboard proper, containing trunk and subscribers' sections. Photographs of switchboards and others showing underground work and conduits complete this part of the exhibit.

A popular feature is the Long Distance booth at the east of the rear entrance. Here each afternoon, between three and five, anyone who wishes may talk for a minute or two with an operator in New York. On the wall near-by is a map of the Long Distance lines accompanied by a number of photographs showing the actual construction.

In the east peristyle are three large double show cases containing the most complete historical collection of telephones in the world, from the parts of Prof. Bell's telephone of 1875, the first that ever transmitted speech, to the latest refinements with which everyone is now familiar, and the sets used by Prof. Bell and Governor Russell at the formal openings of the New York-Chicago and Boston-Chicago Long Distance lines, respectively. Among the interesting early instruments in these cases may be mentioned a reproduction of the 1875 instrument; the Bell "Fig. 5" apparatus, patented March 7th, 1876; the single-pole membrane telephone used at the Centennial by Sir William Thomson and the Emperor of Brazil at the first public exhibition; the double-pole membrane instrument used as a transmitter at the Centennial; a large iron box telephone, a duplicate of the one sent to Sir William Thomson in 1876; the "Fig. 7" receiver and transmitter shown in Professor Bell's first patent; the Centennial liquid transmitter; the first telephone used on a "long line," *i. e.*, between Boston and Cambridge, October 9, 1876; two microphones used by Mr. Blake for his earliest experiments looking toward the production of a commercial transmitter, and other experimental forms to the same purpose; a Bell hand telephone made in 1877, and so on through more recent forms and improvements upon improvements to the instruments of the present hour. Several of the more interesting of these old devices are shown diagrammatically in drawings.



THE ATRIUM, BELL TELEPHONE TEMPLE.



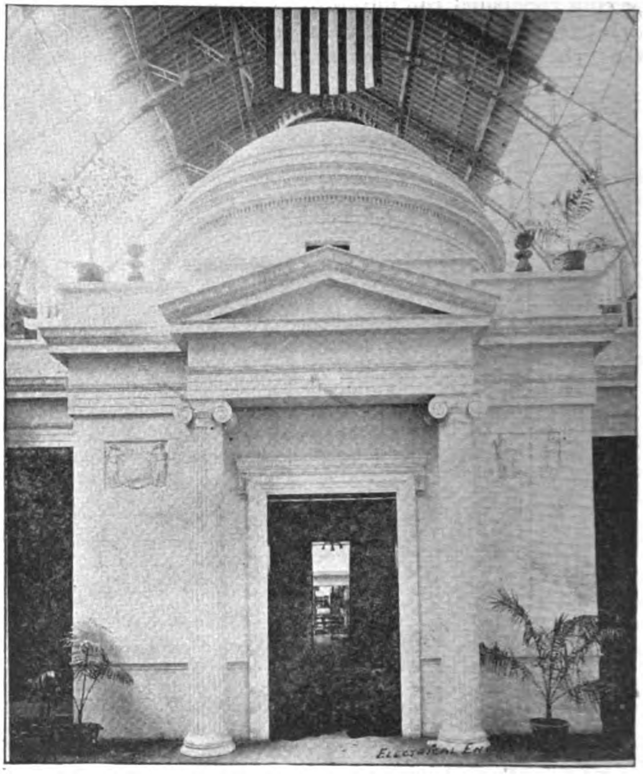
SWITCHBOARD AND DISTRIBUTING FRAME IN THE PERISTYLE.

Upon the walls above the cases are diagrams neatly got up and representing graphically the growth of the telephone business in this country since 1877. From these I gather the following interesting statistics:

The number of persons employed in the telephone exchanges of the United States on Jan. 1, 1881, was 1,481; on Jan. 1, 1893, the number was 9,970. The number of connections between exchange subscribers in 1884 was 215,280,000; in 1893, 600,000,000. The number of telephone subscribers in the United States on Jan. 1, 1881, was 47,880; on Jan. 1, 1893, 232,140. Number of telephones in use in 1877, 5,187; in 1892, 552,720. Miles of wire in use for telephonic purposes, Jan. 1, 1881, 29,714; Jan. 1, 1893, 440,793. Miles of wire in use underground for telephonic purposes,—1885, 1,225; 1893, 91,463. Number of telephone exchanges in 1880, 138; in 1893, 1,351.

At the south end of this peristyle stands a diver's suit, the helmet fitted with a transmitter and receiver. The boat instruments used in connection with them stand upon a table at the north end, the wires running through the tube that supplies the diver with air. Several forms of ship telephones are also shown here.

Just beyond the line of columns is a hotel switchboard connected with a number of instruments throughout the building. Special transmitters and receivers intended for use in mines, and therefore made especially strong and with devices to guard against the admission of moisture, are shown on the walls, as are also a number of office and factory telephones with automatic switches. Four of the latter are in use in the building.



THE INNER TEMPLE, BELL TELEPHONE EXHIBIT.

Within the temple standing upon a pedestal is a transmitter so sensitive that words spoken in an ordinary tone of voice in any part of the room are distinctly heard at the other end of the line. A loud speaking receiver hangs from the dome directly above. Short lectures on the instrument, with practical demonstrations are given here from time to time, and, on special occasions, music is sent over the wires.

The exhibit seems to be one of the most popular in the building, and the temple and court are filled with interested sightseers from morning till night. The reception rooms, too, are delightfully cool and cozy and display the same good taste in their interior decoration and furnishing that marks the temple itself. In fact the exhibit is a success; aesthetically, technically, and educationally.

THE ANSONIA ELECTRIC COMPANY'S EXHIBIT.

One of the most conspicuous pavilions in the Electricity Building is that of the Ansonia Electric Company, of Chicago. This is of graceful Moorish design and extends the entire length of the north gallery facing both ways and having entrances also at the ends, and is one of the strikingly ornamental features of the building. The illustration, from a photograph taken from the roof of the German section, gives an excellent idea of its appearance, though the rich colors used in the decoration add greatly to its beauty. The display consists of a great variety of apparatus, carefully classified and well arranged on boards and in cases, as well as a number of devices in actual operation.

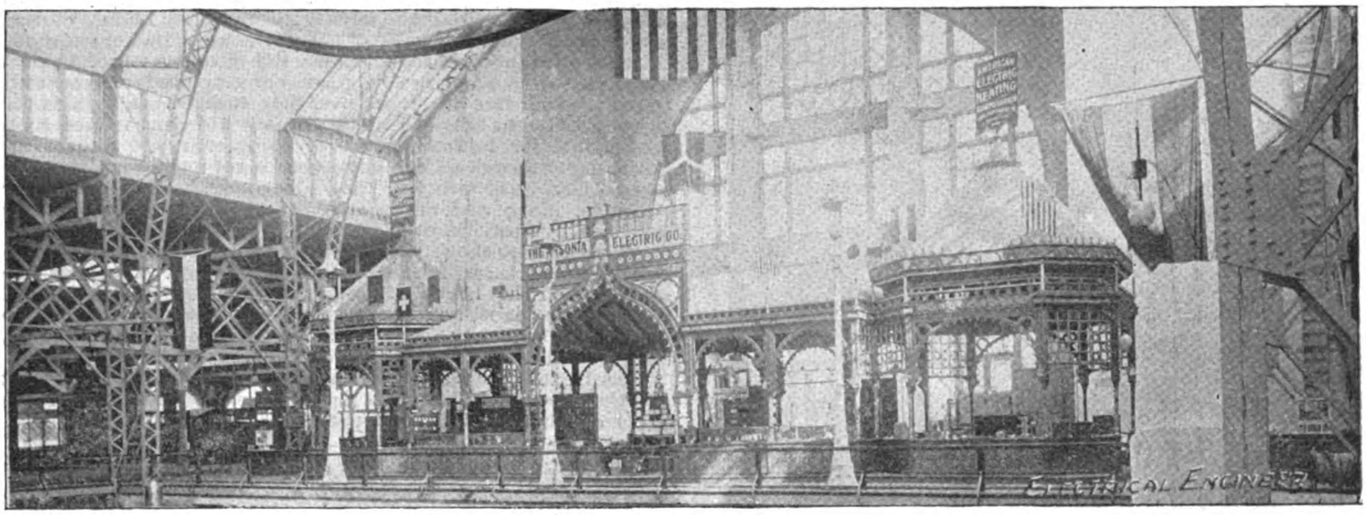


Exhibit of the Ansonia Electric Co., Electricity Building.

Starting at the west end we find first Stanley transformers of all sizes made, ranging from 500 to 5,000 watts. Here also is a table covered with the well-known Lang switches, single, double and triple pole and single and double break, and against the partition is a working model of the automatic electric heat regulator, made by the Electric Thermostat Company, of Temple Court, Minneapolis. This consists of a mechanical thermometer placed in the room where temperature is to be regulated and electrically connected with a spring motor in the furnace or boiler-room which operates check dampers or the valve in the street steam main as the case may be. A card from a recording thermometer used in connection with this device is shown in which the temperature is seen to have varied less than three degrees in an entire week. The central pavilion is divided longitudinally by show boards, on the first of which are hotel and house annunciators, bells, gongs, push buttons, gas lighters, spark coils, etc., while Ajax and Diamond carbon batteries, Ruhmkorff coils, small battery motors and Geissler tubes fill a large case immediately in front. In the centre of the exhibit is a high pyramid of bare and covered copper wire, the latter representing the familiar "Shield Brand." The celebrated Wallace "Telemachon" stands in the main entrance near the pyramid, and other historic Wallace machines occupy prominent positions about the enclosure and contrast strangely with the carefully finished modern apparatus on every side. It will be remembered that a description of these machines appeared in The Electrical Engineer some months since in a series of articles on "William Wallace and his Work," by Mr. W. J. Hammer.

The Cutter Electric Manufacturing Company, of Philadelphia, have a board devoted to switches for controlling lights from a distance, automatic door and lock switches and a variety of flexible brackets. Another interesting device is a Wilkinson & Tinkham electric lock for controlling night latches from any part of the house. This is also shown by a working model. Overhead railway material of the latest Wood pattern, including bridge trolley hangers, angle iron bracket hangers, pull overs, switches, anchor plates, etc., have a large board to themselves, while a smaller board near by shows the evolution of a trolley clamp by Mr. M. M. Wood. Another board shows Wirt indicators, voltmeters, ammeters, electricity meters and dynamo brushes. On another are arranged sections of Habirshaw wires and cables for all purposes. Two specimens are shown of doubled armored submarine cables, the one a positive or negative main of 1,000,000 circular mils and the other a neutral of 350,000 with six pressure wires. Still another board contains specialties made by John R. Fletcher, of Dayton, Ohio, including lamp hangers, and insulators of all sizes and molding.

In the eastern section of the pavilion is a complete exhibit of electrical cooking and heating apparatus made by the Carpenter Electric Heating Manufacturing Co., of St. Paul. The utensils themselves are already familiar to the readers of The Engineer but additional interest is given to the display by the lectures on electric cookery by Miss Helen Louise Johnson, editor of *Table Talk*. A complete electrical kitchen has been fitted up where all manner of good things are cooked in various ways by the simple turning of a switch while Miss Johnson explains the process and tries to convince the public that there is no danger of receiving a fatal shock from eating electrically prepared food. Some of the fool question one hears asked and patiently answered in this attractive spot would furnish themes for a whole book of comic songs.

The pavilion is brightly lighted by Sunbeam incandescent and Helios arc lamps. In the centre is a large monogram of the letters S. E. L. Co., of "acorn" lamps made by the Star Electric Lamp Co. and controlled by a commutator switch. The colors, blue, red, white, green and yellow, appear and vanish, calling attention to the display and affording never ending amusement to the spectators. The company have placed an elevator near their exhibit running between the ground floor and the balcony and have done their utmost to make the entire display both interesting and attractive.

"QUEEN" APPARATUS AT THE WORLD'S FAIR.

The standard electrical instruments exhibited by this company are attracting increased attention each day, and prove of considerable interest to all who appreciate strictly high-class workmanship. The Armour Institute, of Chicago, is equipping an electrical laboratory in good style, and has already reserved some $3,000 worth of the instruments exhibited by Queen & Co.

"NOTHING BUT LEATHER."—THE EXHIBIT OF THE CHAS. MUNSON BELTING COMPANY.

The manufacturers of leather belts especially adapted to dynamo driving have been allotted space together, or rather side by side, on the ground floor of the Electricity Building and have, all of them, produced most novel and ingenious decorative effects in leather besides showing a remarkable variety of belts large and small for all kinds of transmission. Perhaps the most ingenious of all, however, is the exhibit of The Chas. Munson Belting Company, of 22 to 36 Canal street, Chicago, who occupy space D section 3, a good idea of which is given in the accompanying illustration.

The most remarkable thing about this exhibit is that absolutely everything in it is made of leather; floor, tables, chairs, railing, posts, and even the cords that hold back the folds of the Stars and Stripes patriotically festooned over the entrance. The centre table is made simply of two rolls of belting, the lower, which serves as the pedestal, 24 inches in width and the upper 7 inches, while on the latter rests a large disc made of two thicknesses of leather 36 inches in diameter, its surface inlaid with a russet star. On either side of the table is a large leather arm-chair of antique pattern while at one side is a settee consisting of a number of rolls of belting with a piece of belt leather for seat flanked by two larger rolls to serve as arms. The posts and railings are made of leather discs closely packed together on metal rods and highly polished. The most novel thing in the exhibit, though, is the leather carpet of light and dark pieces of geometrical shapes cemented to the floor like tiles and oiled and polished until it has the effect of fine wood parqueterie without its homicidal slipperiness.

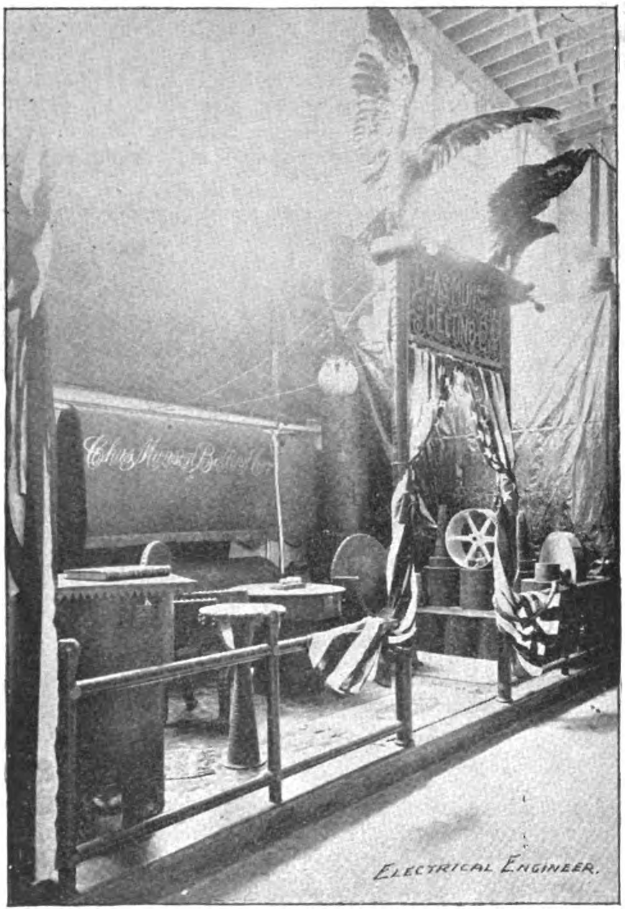


Exhibit of the Munson Belting Co., World's Fair.

The dynamo belts made by this company are all designed to correspond with the speed at which they are intended to run, to overcome loss in the transmission of power, and no single piece of leather larger than 4 feet 2 inches in length is used in their construction. A tanned hide with this part marked out hangs at one end of the space while about the walls are other pieces showing the quality of the material used and the excellence of the tanning. Rolls of large and small belts for various purposes and leather-covered dynamo pulleys complete a most interesting and practical display. With the exception of chairs, railings and carpet, all the material has been taken directly from the stock and will be returned into stock when the Fair is over.

Mr. H. B. Morgan, the company's representative in charge, is also the designer of the entire exhibit.

THE JOSEPH DIXON CRUCIBLE COMPANY AT THE FAIR.

The Joseph Dixon Crucible Company is the only concern in the world which manufactures every article of which graphite is a component part. With the invention by Joseph Dixon in 1827 of the plumbago crucible, the crucible business was revolutionized. At that date began also the manufacture of Dixon's stove polish, foundry facings and the development of an industry now grown to enormous proportions and fittingly represented by the Joseph Dixon Crucible Company.

This company has two exhibits at the Fair. One is of Dixon's "American Graphite Pencils" in the northeast gallery of the Manufacturers' Building, and the other, covering all the other articles manufactured by them, in the northest gallery of the Mines and Mining Building. The pencil exhibit occupies a space 10 x 14 feet. In the centre of this space stands a low mahogany table surmounted by a pyramid of velvet which is covered with pencils arranged in graceful and beautiful designs by an artist employed especially for that purpose. Over this pyramid stands a rosewood and plate glass case. Two ornamental facades of turned and carved mahogany front the space, while it is separated from neighboring spaces by means of Japanese bead curtains, suspended from carved grills.

The space is lighted at night by means of two gilt electroliers of six 16-candle power lights each.

The Company's exhibit of general and special graphite products in the Mines and Mining Building occupies a space 25x28 feet. A very handsome cherry facade fronts the space, while the sides are hung with tastefully arranged portieres. Crucibles, retorts, ladles, stopper-heads and nozzles, graphite boxes, phosphorus chargers, resistance rods and devices, incandescent filament forms and other special goods made of graphite, are shown in upright cabinets. In another case is shown the development of an electrotype plate, in which process the use of graphite is an essential. In still another case are shown over fifty varieties of graphite, for as many different uses and under as many different names, such as graphite for lubricating, stove polish, foundry facings for green, dry or loam castings; core wash, ingot mold wash, shot and powder glazing, electrotyper's and gilder's use, hatter's use, rubber packings, piano and organ actions, "potleading" yachts, for crucibles, lead pencils, paint pigment, lubricants, etc., etc.

There are also shown samples of graphite from all the principal sources from which that article is obtained. One very fine sample from the Island of Ceylon weighs nearly 300 pounds. Comfortable chairs, with writing desk and stationery for the free use of those who may desire it, give to the exhibit an air of genial comfort and ease.

The Dixon Company were the first to complete their exhibit and their promptness brought forth a strong letter of commendation from the Chief of this Department.

PROF. BARRETT'S BIRTHDAY.

Last Saturday, June 24, was the birthday of Prof. J. P. Barrett, Chief of the Department of Electricity, and was seized upon by the representatives of the technical journals at the Fair wholly or in part devoted to electrical subjects as a fitting occasion to show their appreciation of the courtesies extended to them by the executive of the department. Accordingly, late in the afternoon, when the unsuspecting victim was congratulating himself that the day had passed without mishap, he was suddenly made the recipient of a horse shoe magnet six feet high composed of carnations and roses upon which appeared the words, "J. P. Barrett, 1837–1893," while the armature bore the inscription, "The Electrical Press," showing that the papers both stuck to and were stuck on the professor.

EXIT FAKE NO. 1.

It is interesting to note that "Actina, the Great Eye Restorer" has been ordered out of the Electricity Building. The people representing this device were admitted to the building on their statement that they would exhibit primary and secondary batteries of their make. However, time went on and nothing could be seen in their space but a lot of little metallic bottles which, if held against the brow, were supposed to cure shortsightedness, catarrh, and nearly everything else. They were then directed to show something else or leave, and as their reply informed the Department that they had nothing else to show they have been finally ordered out.

"ELECTRICAL INDUSTRIES'" WORLD'S FAIR SUPPLEMENT.

Our monthly contemporary, *Electrical Industries*, has just issued the first number of a weekly supplement devoted to World's Fair matters, under the direction of Mr. H. A. Foster, whose able articles on "Central Station Accounts" in The Electrical Engineer will be well remembered. In addition to descriptions of the exhibits considerable space is devoted to short notes and personal items, and two maps, one of the city of Chicago, and the other of the Electricity Building will form a permanent feature of the publication.

ELECTRIC RAILWAY DEPARTMENT.

THE CITIZENS' STREET RAILWAY OF MUNCIE, IND., WITH NATURAL GAS AS FUEL.

BY

Leslie W. Collins

INTRODUCTORY.

THE city of Muncie, Ind., is located in the famous Indiana gas belt, and as it is the only electric road of any magnitude operated by natural gas. I think a description of its construction may be of interest to our readers.

Having decided to equip their lines with electricity, the Citizens Street Railway Co., of Muncie, began operations on March 7, 1893, at the corner of Wysor and Monroe streets in the presence of the representatives of the city, the officers of the company and a large crowd of people. The first ground was broken by Miss Minnie McKillip, who used a silver shovel in turning the first sod. Work was speedily pushed, as is proven by the fact that in just 49 working days the road was completed and opened for traffic. The completion of this five miles of road is claimed to be the quickest piece of work on record. After encountering extremely bad weather and overcoming all obstacles, the first cars were operated on Saturday, May 13, and the road has been running without interruption every day since starting.

THE POWER HOUSE.

This building, illustrated in Fig. 1, is located on Walnut street and is a handsome two-story brick building with a frontage of 62½ feet, and a depth of 125 feet. The offices of the company occupy the Walnut street front, in which is also located a large and nicely furnished waiting-room. This is somewhat of a departure in street railroading, and is greatly appreciated by the people of Muncie. On the second floor there will be a reading-room and library intended for the special use of motormen and conductors.

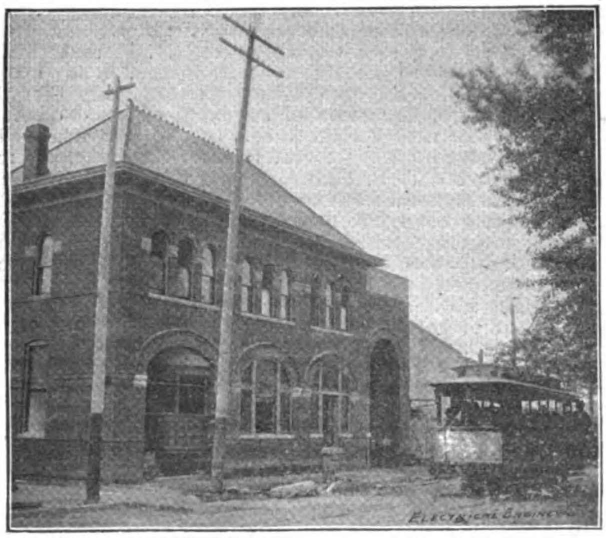


FIG. 1.—POWER HOUSE, MUNCIE, IND., ELECTRIC RAILWAY.

In the rear of this building and forming a part of it is located the engine and dynamo rooms, and back of this again are the car sheds.

THE ENGINE-ROOM.

In this room, which has concrete floors and excellent light and ventilation, are located two 150 h. p. "Ideal" engines running at 250 revolutions. Each engine is belted direct to a 100 k. w. multipolar Thomson-Houston generator, Fig. 2. The cables from the generators are carried underneath the floor to a large and handsome paneled slate switchboard in the centre of the east end of the dynamo-room, also shown in Fig. 2. This is a large room, and with a view to increasing the plant very soon, space has been allowed for two additional engines and generators; in fact, arrangements are already made for the installing of two 200 h. p. multipolar generators, two 300 h. p. engines and two more boilers.

In the engine-room there has been placed a traveling crane with a lifting capacity of ten thousand pounds; this is directly over the generators. With the additions already under construction, the power-house will have a capacity of from 500 to 700 h. p.

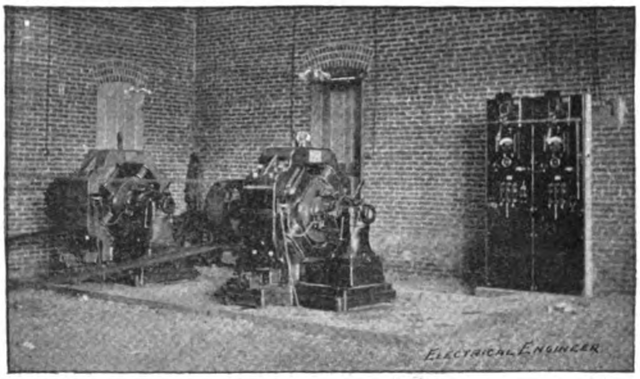


FIG. 2.—GENERATORS AND SWITCHBOARD, MUNCIE, IND., ELECTRIC RAILWAY.

BOILER-ROOM.

Directly back of the engine-room is the boiler-room, which, at present, contains three large boilers with plenty of room for the two additional boilers about to be installed.

The boilers are of the horizontal tubular type of 100 h. p. capacity, carrying a steam pressure of 100 pounds. These boilers were furnished by the well-known firm of Cliff & Co., of Terre Haute, Indiana. Each boiler is supplied with 50 lap-welded steel tubes four inches in diameter. A most interesting feature of this boiler-room is the use of gas as a fuel. One common stack, only 48 inches in diameter, is used for carrying off the gases, and so perfect is the combustion that not a particle of soot has so far been discovered under the boilers.

A little description of the method used here in burning natural gas may be of interest. At about twelve inches below the door liner a row of 2 x 1⅛ inch angle bars are laid lengthwise of the boiler. The angle bars are supported in the side walls and are placed seven inches from centre to centre. Upon these bars is laid a layer of fire brick. These make an air tight joint at the front-end of the boiler and extend to within eight inches of the bridge wall. Eight inches above this layer of brick a row of channel bars was placed, these being also supported by side walls. On top of this is another layer of fire brick flat side down and just level with the top of the door liner, and between the door liner and the fire brick a space of eight inches is left and in this case the brick is fitted close up to the bridge wall, making an air-tight joint. Now in this eight inch space between door liner and the top layer of brick is placed a burner which consists of a four-inch pipe having a series of ⅜-inch holes placed at an angle of 60 degrees to the horizontal plane.

The advantage in this arrangement can readily be seen. The cold air coming in through the door of the ash pit passes to the rear, thence up through the space between the two layers of fire brick to the front of the boiler, there passing through the space between the burner and top layer of fire brick, becoming heated as it does on this passage. It will be seen that a good mixer is provided besides the effect of heating the cold gases before they come in contact with the flame, thereby effecting a more economical and most complete combustion.

Before entering the boilers, the water is passed through a 300 h. p. Hoppes feed-water purifier, the utility of which has been strikingly demonstrated thus far inasmuch as no scale whatever has formed in the boilers. The pumping plant, Fig. 3, consists of two 3¼ x 5¼ x 7¼ Dean pumps. The pumps are so arranged that both can be used to pump hot water from the heater; or by shutting off the heater they can be used to pump cold water from the city mains. Or, one pump can be used to pump cold water into the boilers, while the other is pumping hot water. A line has also been run over the top of the boilers and tapped into the city water by means of which cold water can be run into the boilers under the pressure of the city water. This, of course, would only be used for cleaning out the boilers after blowing off, etc. All valves are so arranged as to be accessible from the side of the boiler, thus obviating the necessity of having the fireman go to the rear of the boiler to regulate the feed-water valve.

The pump lines are connected to a heater three feet long and made of eight-inch pipe, plugged at each end. Both pump lines tap into one side of this heater, while the feed-water lines are taken out of the other side. It will be seen that this affords a very flexible arrangement and reduces to a minimum the liability of a shut down due to any derangement of the pumps, heater or feed-water lines, as each boiler has its own feed line. Each boiler is provided with a six-inch blow-off pipe.

THE CAR HOUSE.

The car house consists of a brick building 125 feet long by 62½ wide situated directly in the rear of the power house, and has been designed to hold 28 cars. The tracks run into the car house from the gangway at the side of the power house on Walnut street, and another from the rear of the car house on High street. Two long pits, 125 feet in length, have been placed in the car house, and the cars are transferred to the different tracks by a transfer table.

TRACK CONSTRUCTION.

Within the corporate limits, the track is laid with 60 lb. Shanghai rail, of the Illinois Steel Company, Section, 6,012. Beyond the corporate limits 48 lb. rail has been used. Angle plates have been used to connect all joints, and two ties have been placed under each joint. The entire road-bed has been graveled and the track throughout is double bonded with No. 0 tinned copper bond wire, held in place with channel pins, and at every 90 feet a cross bond has been placed. At every 440 yards a rail has been sunk into the ground to a depth of about 10 feet and connected to both sides of the track with No. 0 copper bond wire. As the road for a considerable distance passes along the banks of the White River, very good grounds have been obtained.

The rail is laid on white oak ties. Within the corporate limits, ties 8 in. x 6 in. x 8 feet long have been used. Beyond the corporate limits the standard railroad tie, 5 in. x 7 in. x 7 feet long has been used. All these ties are white and burr oak. The rail has been spiked to the standard ties with a 5½ x $\frac{9}{16}$ inch spike, while on all the other ties a 4½ x ½ inch spike has been used.

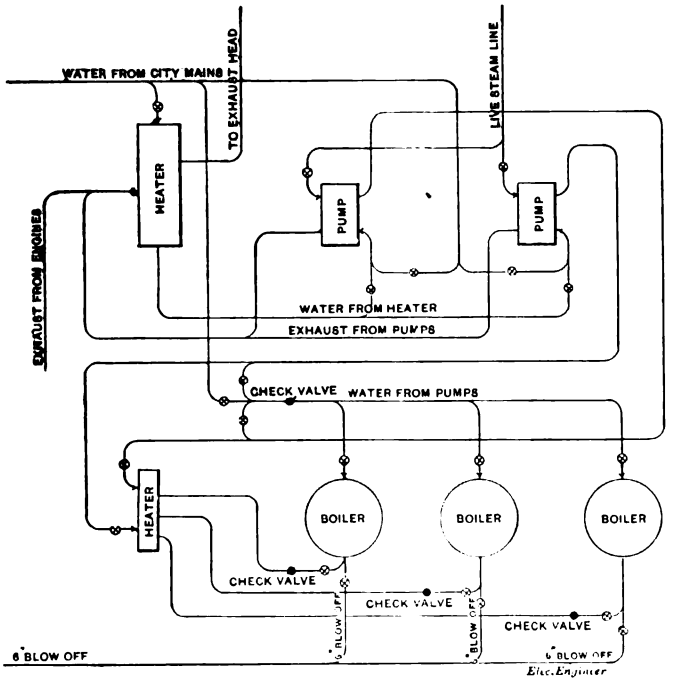


FIG. 3.—PUMPING PLANT, MUNCIE, IND., ELECTRIC RAILWAY.

The company have built four trestles—the longest one being 175 feet in length and 18 feet high. They have also already constructed two iron bridges, the contract for which was taken by the Indiana Bridge Company. One of these bridges connects Whitely with Muncie, while the other spans the White River just beyond the city limits on the Wheeling Pike. The Whitely bridge is 208 feet long, while the other is approximately 275 feet long.

OVERHEAD CONSTRUCTION.

The trolley line consists of No. 0 hard drawn Lake Superior copper wire. The pole line throughout is composed of white cedar poles, 30 feet long. These poles are 8 inches at the top, having been cut down from a 35 foot, 7-inch top pole. All the overhead parts such as hangers, etc., were furnished by the General Electric Company. The ears throughout are soldered to the trolley wire. About 1¼ miles of bracket construction has been used. So thorough and careful was the construction of the overhead lines that when the original test was made some days ago before starting, not a single ground or defect of any kind developed. The road has been operating since the 12th of May and thus far no low joints or springy places in the track have developed.

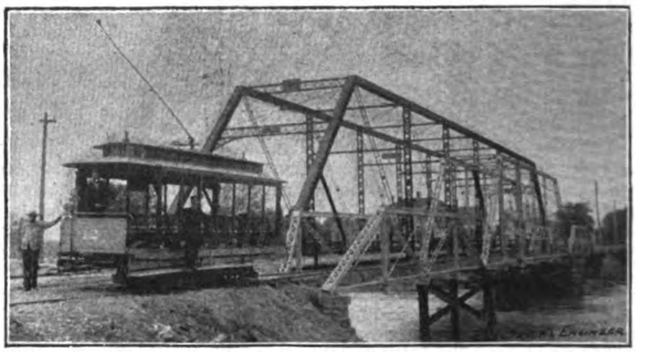


FIG. 4.—BRIDGE OVER WHITE RIVER, MUNCIE, IND., ELECTRIC RAILWAY.

Three No. 2/0 feed wires are tapped into the trolley wire at different points. Return leads are carried out over the poles and tap into the rail at different points of the line, thus making practically a metallic circuit.

The entire station, and all dark points on the line, are lit up by incandescent lights. In addition to this, gas burners have been placed at intervals sufficient to provide for the emergency of an accident at the station.

The plan and details of this work were all designed and carried to their completion by Mr. W. C. Gotshall, of St. Louis, who acted as chief engineer and superintendent, and the entire work of Mr. Gotshall has been so satisfactory to the company that he has been retained as general manager of the road.

The electric generators were furnished through the Chicago office of the General Electric Company, and are what is known as the 100 M. P. generators. The generators are designed to run at 650 revolutions, and are each adjusted for 10 per cent. drop of potential. They have been working perfectly, so that thus far neither of them has been shut down or repaired in any manner. In fact, the plant has been operating so satisfactorily that there has not been an interruption of any kind since the day it was started. The electrical equipment throughout was furnished by the Chicago office of the General Electric Company, and much credit is due to Mr. T. P. Bailey for the manner in which the delivery of the material was expedited.

The company have just recently completed a splendid baseball park, including grand stand, and have finished a three-mile extension to their road to reach this park. This, it is expected, will be completed before the end of June. They have also just ordered eight additional cars from the St. Louis Car Co., the electrical equipment for them being furnished by the General Electric Co. The officers of the company are: I. S. Keily, president; J. S. Tally, vice-president; J. R. Scott, treasurer; Geo. F. McCulloch, secretary; and Mr. W. C. Gotshall, general manager and superintendent.

The writer wishes to acknowledge his indebtedness to Mr. W. C. Gotshall, for the information contained in this article.

LIFE-SAVER FOR ELECTRIC CARS.

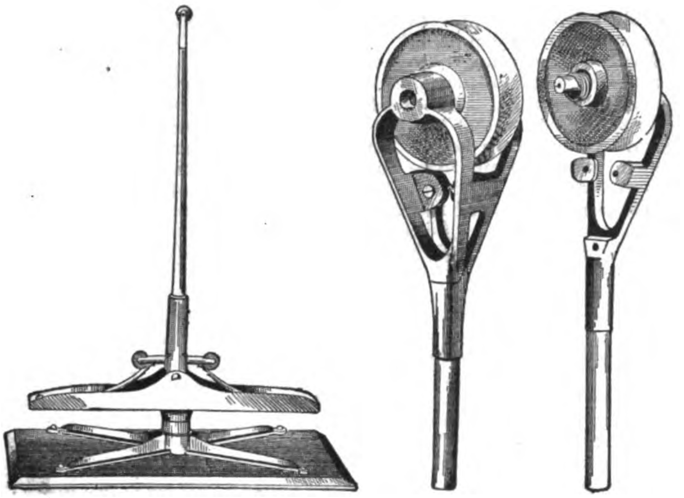
A FENDER for electric cars was exhibited at Crescent Beach, near Boston, a few days ago, before members of the city government and business men of Boston. The inventor is M. F. Field, of Boston, who claims that with this fender any object or person on the track will be easily and safely removed.

The fender is materially different from any seen on the cars at present. It extends in front of the car 24 inches, and is formed of a series of steel wires that curve from the platform in a gentle swell to the bar in the front of the fender which is a few inches above the track.

A body striking the fender is scooped up into the wires owing to their elasticity, and the weight bends the wires so as to prevent its rolling off in front of the car.

THE NEW ALLEN TROLLEY.

One of the essential features of the modern electric railway is the trolley, and there is scarcely any part of an electric car equipment which is subjected to harder usage than the little wheel which conveys the current from the trolley wire to the motor. Necessarily of small diameter and required at the same time to take heavy currents on frequent occasions it is no small matter to avoid difficulties which have in the past given rise to much trouble and expense. Both these have, however, been overcome in the new Allen trolley illustrated in the accompanying engravings. In this trolley the wheel is firmly attached to a spindle which revolves in fibre graphite bearings. These bearings are self-lubricating and hence require no oil, which would introduce a resistance in the circuit, and gives rise to much annoyance besides being always uncleanly. The springs are placed inside the wheel and necessarily keep perfect contact. Besides its other excellent qualities, the wheel runs entirely without noise, there being no bushings to wear out and cause rattle.



New Allen Trolley.

The Allen trolley is manufactured by the Allen Trolley Co., of 234 Carter street, Philadelphia.

HENRY'S IMPROVEMENTS IN ELECTRIC RAILWAY METHODS.

In a series of patents just issued to Mr. John C. Henry, that inventor describes a number of interesting features in connection with electric railway work. Among them is one relating to a special device for pressing the collector or trailer against the underside of the trolley wire; the collector is supported upon a standard at the end of a platform and not upon the roof as is now usually practiced. By means of a sliding pole arrangement the collector can be raised and lowered to conform to the various inequalities in the height of the trolley wire.

In another patent he describes a novel method of supporting the motors of railway cars. In this the side bars are pivoted at one end, the armature being mounted between the bars with one pole piece carried at the end of the bars distant from the axle upon which the magnetizing coil is mounted, and a consequent pole piece mounted upon the axle itself. The gear case enclosing the gears is made of non-magnetic metal.

In a railway system designed for underground conductors, Mr. Henry provides a continuous conductor, and beside it an iron pin the normal position of which is level with the street. This pin carries a brush at its lower end, which normally is out of contact with the conductor. Suspended from the lower end of the car is a magnet, which, as it passes over the iron pin draws it up and brings the brush carried by it in contact with the conductor, thus closing the circuit through the car. After the car passes off, the pin drops and electrical connection is broken at that point of the conductor to be made at the next pin.

In another system in which a number of cars are run as a train, Mr. Henry employs a high speed dynamotor on one car, having its motor shunt wound, and individual slow speed series wound motors on the other cars of the train, coupled in series with the generator armature of the dynamotor; variation in speed is obtained by varying the E. M. F. and current of the generator.

In another patent he describes a combination of two complete motor circuits with a switch having stationary contacts to which are attached the independent terminals of the armature and field coil. The connections are movable with the switch, and are so arranged that each of the motor circuits can be placed in parallel or in series, or one may be added or dropped from the circuit. By this means in the event of accidental cross or grounds, the defective portion can be switched out of circuit, leaving the other still capable of propelling the car.

LETTERS TO THE EDITOR.

ELECTRICAL THEORY.

Prof. Arner's recent contribution to your columns under the above heading[1], wherein he makes a plea for a more rational treatment of the science of electricity, seems to me to have for its basis a misconception of what an exact science of electricity must really be. Prof. Arner's proposal, as I understand it, is to build up a science on a basis of mechanical facts, which is, of course, much to be desired, and will eventually be given us, either by that slow and gradual growth which the continued accumulation of data must in time produce, or suddenly, by the flashing forth of the whole grand idea from some master mind. Of the former manner, the development of the mechanical theory of heat based on the doctrines of the transmutability of force and the conservation of matter and of force, the law of gravitation are good examples, although Newton builds on Kepler and his forerunners.

But Mr. Arner would build up a science on the basis of effects, or, at least, secondary causes and not on ultimate causes, for the example he cites is that of a machine in which the kinematic relations of the finished members alone, are to be considered. The sources of energy he entirely disregards, and in fact, mentions as "not concerning us" the stress and strain along the path of energy. But this "stress and strain," within certain limits, is just that upon which the science must in future be based.

Electricity is not a science which, like mineralogy, botany, or any of the more concrete sciences (*sit venia verbo!*) can be fully grasped more by studying the substance which the hands enfold and the eye beholds, than by allowing the eye of imagination to rove to all possible arrangements of molecules or atoms and their relative stations, movements and states, but is a science, at least, as yet, of a purely abstract type, notwithstanding all that has been said to the contrary by practical men. I mean thereby a science where the endeavor to grasp the ultimate cause, or even the visible effect (if one may separate the two), compels the mind to borrow from its imaginative *centrum*, and combined with its logical reasoning power, still to admit that we have an exact science built on a hypothetical groundwork only. We lack the non-hypothetical certainty of one grand but simple universal law from which we could deduce or wherein we could place all details.

The fact that the "special treatment" of the science exists has for its apology the lack of our knowledge of the mechanical laws governing the inter-movement of the—in themselves hypothetical—molecules or atoms, that is to say, the power to predict the results of their mutual interference from the consideration of the nature of the interference itself. Until we reach this stage, when Sir William Thomson's assertion or definition that—"molecules of a substance are pieces of matter of measurable dimensions, with shape, motion, laws of action, intelligible subjects of scientific investigation"—becomes an incontrovertible fact, until then will the science of electricity continue to labor under the disadvantage, as above stated, of being an exact science resting on hypothetical foundations. The cardinal principle, as Fleming says, of all modern methods of viewing the phenomena of electricity, is the *denial of action at a distance* and to mention only the finite propagation of the waves of light and the impossibility of accounting for this *fact* by any other hypothesis than that of actual transmission of something across space or the propagation of a state of stress and strain across a medium—all tend to verify the existence of an actual medium; and yet Mr. Arner mentions the rôle that "*action at a distance*" still plays.

When the Maxwellian principle that *change in electric displacement is an electric current* becomes a quantity fit for mathematical calculation, then will the science of electricity be ready for its natural treatment.

Newark, N. J. Herman A. Strauss.

AN INTERESTING CHANGE IN THE TAYLOR, TEX., LIGHTING PLANT.

Mr. T. E. Mason, the superintendent and electrical engineer of the Taylor Electric Light, Gas and Power Company, of Taylor, Tex., writes us that the plant there, which was of the low-tension three-wire Fort Wayne system, has been changed to the Fort Wayne alternating system without having any lights out on the circuit or without any shutting down. This was done with the more difficulty because there was only one engine, belting direct to the dynamos, and the old dynamos stood on the same ground that the new ones occupy. The new switchboard also stands exactly where the old one did. The work was completed in 30 days at a total expense of $8,000. The company also removed from its poles six No. 000 bare wires and put up covered No. 1 in their place. The company now has a very complete new plant and equipment. It has a Buckeye engine of 120 h. p. Mr. C. Mendel is president of the company, and J. A. Thompson treasurer.

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[1] The Electrical Engineer, May 24, 1893.

MISCELLANEOUS.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.[1]—V.

(*Concluded*).

BY NIKOLA TESLA.

In the experiment before cited it is, of course, open to say, that the glass tube upon coming in contact with the filament, retains a charge of a certain sign upon the point of contact. If now the filament again touches the glass at the same point while it is oppositely charged, the charges equalize under evolution of light. But nothing of importance would be gained by such an explanation. It is unquestionable that the initial charges given to the atoms or to the glass play some part in exciting phosphorescence. So, for instance, if a phosphorescent bulb be first excited by a high frequency coil by connecting it to one of the terminals of the latter and the degree of luminosity noted, and then the bulb be highly charged from a Holtz machine by attaching it preferably to the positive terminal of the machine, it is found that when the bulb is again connected to the terminal of the high frequency coil, the phosphorescence is far more intense. On another occasion I have considered the possibility of some phosphorescent phenomena in bulbs being produced by the incandescence of an infinitesimal layer on the surface of the phosphorescent body. Certainly, the impacts of the atoms are powerful enough to produce intense incandescence by the collisions, since they bring quickly to a high temperature a body of considerable bulk. If any such effect exists, then the best appliance for producing phosphorescence in a bulb, which we know so far, is a disruptive discharge coil giving an enormous potential with but few fundamental discharges, say 25–30 per second, just enough, to produce a continuous impression upon the eye. It is a fact that such a coil excites phosphorescence under almost any condition and at all degrees of exhaustion, and I have observed effects which appear to be due to phosphorescence even at ordinary pressures of the atmosphere, when the potentials are extremely high. But if phosphorescent light is produced by the equalization of charges of electrified atoms (whatever this may mean ultimately), then the higher the frequency of the impulses or alternate electrifications, the more economical will be the light production. It is a long known and noteworthy fact that all the phosphorescent bodies are poor conductors of electricity and heat, and that all bodies cease to emit phosphorescent light when they are brought to a certain temperature. Conductors on the contrary do not possess this quality. There are but few exceptions to the rule. Carbon is one of them. Becquerel noted that carbon phosphoresces at a certain elevated temperature preceding the dark red. This phenomenon may be easily observed in bulbs provided with a rather large carbon electrode (say a sphere of six millimetres diameter). If the current is turned on after a few seconds, a snow white film covers the electrode, just before it gets dark red. Similar effects are noted with other conducting bodies, but many scientific men will probably not attribute them to true phosphorescence. Whether true incandescence has anything to do with phosphorescence excited by atomic impact or mechanical shocks still remains to be decided, but it is a fact that all conditions, which tend to localize and increase the heating effect at the point of impact, are almost invariably the most favorable for the production of phosphorescence. So, if the electrode be very small, which is equivalent to saying in general, that the electric density is great, if the potential be high, and if the gas be highly rarefied, all of which things imply high speed of the projected atoms, or matter, and consequently violent impacts—the phosphorescence is very intense. If a bulb provided with a large and small electrode be attached to the terminal of an induction coil, the small electrode excites phosphorescence while the large one may not do so, because of the smaller electric density and hence smaller speed of the atoms. A bulb provided with a large electrode may be grasped with the hand while the electrode is connected to the terminal of the coil and it may not phosphoresce; but if instead of grasping the bulb with the hand, the same be touched with a pointed wire, the phosphorescence at once spreads through the bulb, because of the great density at the point of contact. With low frequencies it seems that gases of great atomic weight excite more intense phosphorescence than those of smaller weight, as for instance, hydrogen. With high frequencies the observations are not sufficiently reliable to draw a conclusion. Oxygen, as is well-known, produces exceptionally strong effects, which may be in part due to chemical action. A bulb with hydrogen residue seems to be most easily excited. Electrodes which are most easily deteriorated produce more intense phosphorescence in bulbs, but the condition is not permanent because of the impairing of the vacuum and the deposition of the electrode matter upon the phosphorescent surfaces. Some liquids as oils, for instance, produce magnificent effects of phosphorescensce (or fluorescence ?), but they last only a few seconds. So if a bulb have a trace of oil on the walls and the current is turned on, the phophorescence only persists for a few moments until the oil is carried away. Of all bodies so far tried, sulphide of zinc seems to be the most susceptible to phosphorescence. Some samples obtained obtained through the kindness of Prof. Henry in Paris, were employed in many of these bulbs. One of the defects of this sulphide is, that it loses its quality of emitting light when brought to a temperature which is by no means high. It can therefore, be used only for feeble intensities. An observation which might deserve notice is, that when violently bombarded from an aluminum electrode it assumes a black color, but singularly enough, it returns to the original condition when it cools down.

The most important fact arrived at in pursuing investigations in this direction is, that in all cases it is necessary, in order to excite phosphorescence with a minimum amount of energy, to observe certain conditions. Namely, there is always, no matter what the frequency of the currents, degree of exhaustion and character of the bodies in the bulb, a certain potential (assuming the bulb excited from one terminal) or potential difference (assuming the bulb to be excited with both terminals) which produces the most economical result. If the potential be increased, considerable energy may be wasted without producing any more light, and if it be diminished, then again the light production is not as economical. The exact condition under which the best result is obtained seems to depend on many things of a different nature and it is to be yet investigated by other experimenters, but it will certainly have to be observed when such phosphorescent bulbs are operated, if the best results are to be attained.

Coming now to the most interesting of these phenomena, the incandescence or phosphorescence of gases, at low pressures or at the ordinary pressure of the atmosphere, we must seek the explanation of these phenomena in the same primary causes, that is, in shocks or impacts of the atoms. Just as molecules or atoms beating upon a solid body excite phosphorescence in the same or render it incandescent, so when colliding among themselves they produce similar phenomena. But this is a very insufficient explanation and concerns only the crude mechanism. Light is produced by vibrations which go on at a rate almost inconceivable. If we compute, from the energy contained in the form of known radiations in a definite space the force which is necessary to set up such rapid vibrations, we find, that though the density of the ether be incomparably smaller than that of any body we know, even hydrogen, the force is something surpassing comprehension. What is this force, which in mechanical measure, may amount to thousands of tons per square inch? It is electrostatic force in the light of modern views. It is impossible to conceive how a body of measurable dimensions could be charged to so high a potential that the force would be sufficient to produce these vibrations. Long before any such charge could be imparted to the body it would be shattered into atoms. The sun emits light and heat, and so does an ordinary flame or incandescent filament, but in neither of these can the force be accounted for if it be assumed that it is associated with the body as a whole. Only in one way may we account for it, namely, by identifying it with the atom. An atom is so small, that if it be charged by coming in contact with an electrified body and the charge be assumed to follow the same law as in the case of bodies of measurable dimensions, it must retain a quantity of electricity which is fully capable of accounting for these forces and tremendous rates of vibration. But the atom behaves singularly in this respect, it always takes the same "charge."

It is very likely that resonant vibration plays a most important part in all manifestations of energy in nature. Throughout space all matter is vibrating, and all rates of vibration are represented, from the lowest musical note to the highest pitch of the chemical rays, hence an atom, or complex of atoms, no matter what its period, must find a vibration with which it is in resonance. When we consider the enormous rapidity of the light vibrations, we realize the impossibility of producing such vibrations directly with any apparatus of measurable dimensions, and we are driven to the only possible means of attaining the object of setting up waves of light by electrical means and economically, that is, to affect the molecules or atoms of a gas, to cause them to collide and vibrate. We then must ask ourselves—How can free molecules or atoms be affected?

It is a fact that they can be affected by electrostatic force, as is apparent in many of these experiments. By varying the electrostatic force we can agitate the atoms, and cause them to collide under evolution of heat and light. It is not demonstrated beyond doubt that we can affect them otherwise. If a luminous discharge is produced in a closed exhausted tube, do the atoms arrange themselves in obedience to any other but to electrostatic force acting in straight lines from atom to atom? Only recently I investigated the mutual action between two circuits with extreme rates of vibration. When a battery of a few jars (*c c c c*, Fig. 32) is discharged through a primary P of low resistance (the connections being as illustrated in Figs. 19*a*, 19*b* and 19*c*), and the frequency of vibration be many million there are great differences of potential between points on the primary not more than a few inches apart. These differences may be 10,000 volts per inch, if not more, taking the maximum value of the E. M. F.

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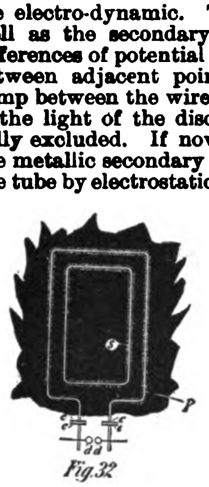
[1] A lecture delivered before the Franklin Institute, at Philadelphia, Feb. 24 1893, and before the National Electric Light Association, at St. Louis, Mo., March 1, 1893.

The secondary *s* is therefore acted upon by electrostatic induction, which is in such extreme cases of much greater importance than the electro-dynamic. To such sudden impulses the primary as well as the secondary are poor conductors, and therefore great differences of potential may be produced by electrostatic induction between adjacent points on the secondary. Then sparks may jump between the wires and streamers become visible in the dark if the light of the discharge through the spark gap *d d* be carefully excluded. If now we substitute a closed vacuum tube for the metallic secondary *s*, the differences of potential produced in the tube by electrostatic induction from the primary are fully sufficient to excite portions of it; but as the points of certain differences of potential on the primary are not fixed, but are generally constantly changing in position, a luminous band is produced in the tube, apparently not touching the glass, as it should, if the points of maximum and minimum differences of potential were fixed on the primary. I do not exclude the possibility of such a tube being excited only by electro-dynamic induction, for very able physicists hold this view; but in my opinion, there is as yet no positive proof given that atoms of a gas in a closed tube may arrange themselves in chains under the action of an electromotive impulse produced by electro-dynamic induction in the tube. I have been unable so far to produce striæ in a tube, however long, and at whatever degree of exhaustion, that is, striæ at right angles to the supposed direction of the discharge or the axis of the tube, but I have distinctly observed in a large bulb, in which a wide luminous band was produced by passing a discharge of a battery through a wire surrounding the bulb, a circle of feeble luminosity between two luminous bands, one of which was more intense than the other. Furthermore, with my present experience I do not think that such a gas discharge in a closed tube can vibrate, that is, vibrate as a whole. I am convinced that no discharge through a gas can vibrate. The atoms of a gas behave very curiously in respect to sudden electric impulses. The gas does not seem to possess any appreciable inertia to such impulses, for it is a fact, that the higher the frequency of the impulses, with the greater freedom does the discharge pass through the gas. If the gas possesses no inertia then it cannot vibrate, for some inertia is necessary for the free vibration. I conclude from this that if a lightning discharge occurs between two clouds, there can be no oscillation, such as would be expected, considering the capacity of the clouds. But if the lightning discharge strike the earth, there is always vibration—in the earth, but not in the cloud. In a gas discharge each atom vibrates at its own rate, but there is no vibration of the conducting gaseous mass as a whole. This is an important consideration in the great problem of producing light economically, for it teaches us that to reach this result we must use impulses of very high frequency and necessarily also of high potential. It is a fact that oxygen produces a more intense light in a tube. Is it because oxygen atoms possess some inertia and the vibration does not die out instantly? But then nitrogen should be as good, and chlorine and vapors of many other bodies much better than oxygen, unless the magnetic properties of the latter enter prominently into play. Or, is the process in the tube of an electrolytic nature? Many observations certainly speak for it, the most important being, that matter is always carried away from the electrodes and the vacuum in a bulb cannot be permanently maintained. If such process takes place in reality, then again must we take refuge in high frequencies, for with such, electrolytic action should be reduced to a minimum, if not rendered entirely impossible. It is an undeniable fact that with very high frequencies, provided the impulses be of a harmonic nature, like those obtained from an alternator, there is less deterioration and the vacua are more permanent. With disruptive discharge coils there are sudden rises of potential and the vacua are more quickly impaired, for the electrodes are deteriorated in a very short time. It was observed in some large tubes, which were provided with heavy carbon blocks B B$_1$, connected to platinum wires w w_1 (as illustrated in Fig. 33), and which were employed in experiments with the disruptive discharge instead of the ordinary air gap, that the carbon particles under the action of the powerful magnetic field in which the tube was placed, were deposited in regular fine lines in the middle of the tube as illustrated. These lines were attributed to the deflection or distortion of the discharge by the magnetic field, but why the deposit occurred principally where the field was most intense did not appear quite clear. A fact of interest, likewise noted, was that the presence of a strong magnetic field increases the deterioration of the electrodes, probably by reason of the rapid interruptions it produces, whereby there is actually a higher E. M. F. maintained between the electrodes.



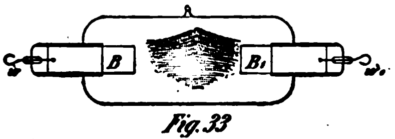


FIG. 32.—ELECTROSTATIC ACTION BETWEEN PRIMARY AND SECONDARY, WITH EXTREMELY HIGH FREQUENCIES.

FIG. 33.—CARBON DEPOSIT IN TUBE IN A MAGNETIC FIELD.

Much would remain to be said about the luminous effects produced in gases at low or ordinary pressures. With the present experiences before us we cannot say that the essential nature of these charming phenomena is sufficiently known. But investigations in this direction are being pushed with exceptional ardor. Every line of scientific pursuit has its fascinations, but electrical investigation appears to possess a peculiar attraction, for there is no experiment or observation of any kind in the domain of this wonderful science which would not forcibly appeal to us. Yet to me it seems, that of all the many marvelous things we observe, a vacuum tube, excited by an electric impulse from a distant source, bursting forth out of the darkness and illuminating the room with its beautiful light, is as lovely a phenomenon as can greet our eyes. More interesting still it appears when, reducing the fundamental discharges across the gap to a very small number and waving the tube about we produce all kinds of designs in luminous lines. So by way of amusement, I take a straight long tube, or a square one, or a square attached to a straight tube and by whirling them about in the hand, I imitate the spokes of a wheel, a Gramme winding, a drum winding, an alternate current motor winding, etc. (Fig. 34). Viewed from a distance the effect is weak and much of its beauty is lost, but being near or holding the tube in the hand one cannot resist its charm.

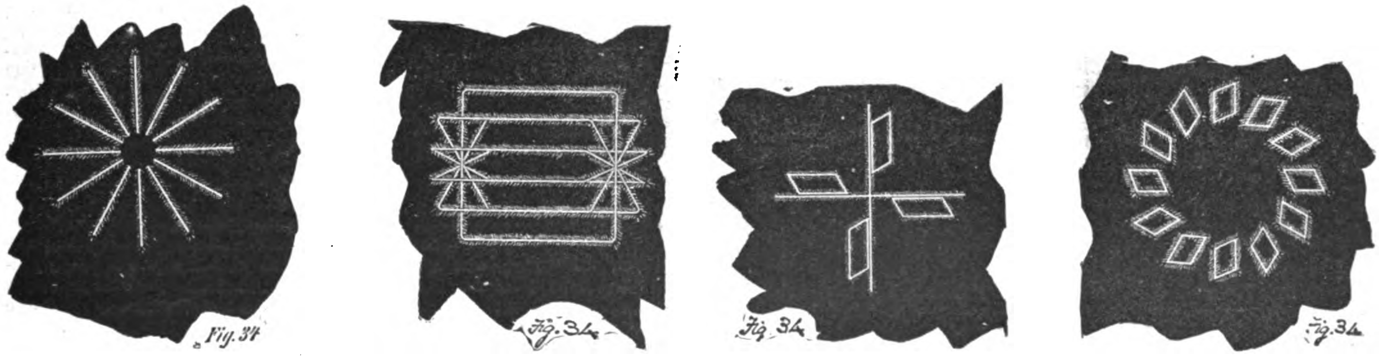


FIG. 34. { SPOKE WHEEL, DRUM WINDING, ALTERNATE MOTOR WINDING, RING WINDING, } SOME OF THE DESIGNS PRODUCED BY INTERMITTENT DISCHARGES.

In presenting these insignificant results I have not attempted to arrange and co-ordinate them as would be proper in a strictly scientific investigation in which every succeeding result should be a logical sequence of the preceding, so that it might be guessed in advance by the careful reader or attentive listener. I have preferred to concentrate my energies chiefly upon advancing novel facts or ideas which might serve as suggestions to others, and this may serve as an excuse for the lack of harmony. The explanations of the phenomena have been given in good faith and in the spirit of a student prepared to find that they admit of a better interpretation. There can be no great harm in a student taking an erroneous view, but when great minds err, the world must dearly pay for their mistakes.

THE PITTSBURGH GAS ENGINE.

It is becoming rather late in the day to enter upon a presentation of the arguments in favor of the gas engine as a mechanism for furnishing power, for even when all the objections that can be raised against the gas engine are conceded as substantial, when the peculiar defects of individual types have all been admitted, the fact remains that this new motor has made a place for itself. In efficiency it has already rivaled the steam engine, despite the limitations, hitherto, of a comparatively small range of size and capacity, while in adaptability to the wants of an endless variety of industries, it has been a serious rival of the electric motor. At the same time, it has met a necessity of modern methods of lighting and power by providing for electric generators a new motive agency, so that where electric circuits from a central station are not available, it has still been possible by its instrumentality to enjoy whatever of advantage and superiority electricity may yield. In other words, the gas engine is the great link between the old practice and the new in illumination and power, and its importance and value make a deeper impression every year upon the public mind.

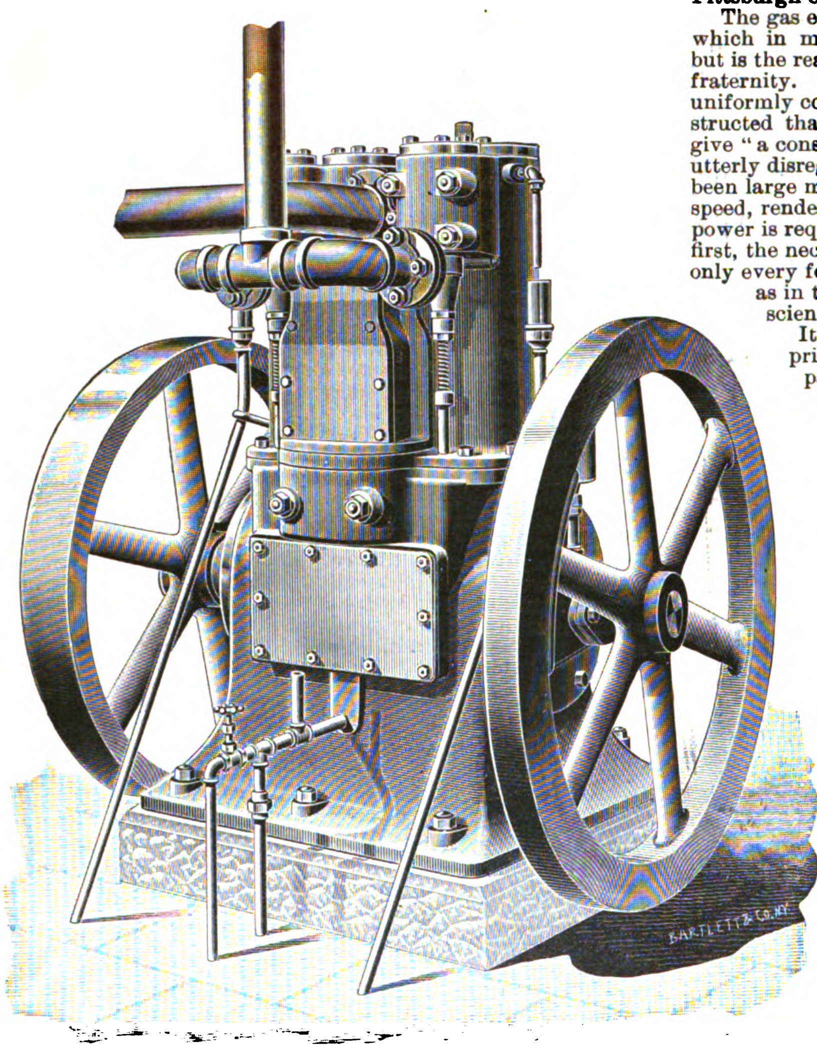

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Fig. 1.—The Pittsburgh Gas Engine for Electric Lighting.

These considerations have been influential with the designer of the Pittsburgh Gas Engine, and with the Fuel Gas and Manufacturing Co., of Pittsburgh, its builder. It was the conviction of the designer that the failure of gas engines, of older and familiar type, to meet the demands upon them was due to conditions which skillful engineering and careful construction could overcome. It was also the belief of the Company that, furnished with such an engine as would realize its expectations as to economy and efficiency, it could not only secure a position in the field as it now exists, but create new markets, that were supposed to be entirely beyond the range of gas as a motive power. It is the object of the present article to discuss briefly the chief features of the situation created by the advent of a new gas engine of greater range, efficiency and usefulness than was ever reached before, and to show how the most scientific principles have been satisfactorily worked out in the new machine.

The Pittsburgh Gas Engine is not merely a happy thought. It is the product of deeply studied design, corrected, refined and perfected by a long series of experiments in which each detail has been taken alone and made to carry the evolution of the new type to the furthest point possible to the art.

Reasoning from theoretical premises alone, the gas engine will be found to have a total efficiency of about 85 per cent., a figure which, of course, has never been attained in practice, as the best heat motors heretofore known only deliver in the form of work about one quarter of the total energy put into them. But we all know that the steam engine, owing to inherent defects has practically reached the limit of its economy, while the gas engine has still abundant opportunity for improvement, before the practical shall reach the theoretical efficiency.

One feature, which at first sight would seem to operate against the economical operation of the gas engine, is the increased cost necessitated in the use of gas as a fuel; but practice has already proven that any good gas engine will more than offset this increased cost by its comparatively high efficiency. We leave it for the figures hereafter given to prove how conclusively the Pittsburgh engine answers this apparent objection.

The gas engine has had at least a single important deficiency, which in most cases has not only discounted its good qualities, but is the real cause of its slow acceptance by the engineering fraternity. This deficiency has been its inability to maintain a uniformly constant speed. Some of the best engines are so constructed that while it may be truthfully claimed that they will give "a constant number of revolutions per minute," such a rating utterly disregards the fact that during the minute there may have been large momentary fluctuations above and below the average speed, rendering these engines worthless where absolutely steady power is required. The variations of speed are due to two causes: first, the necessity of admitting the working fluid to the cylinder only every fourth or sixth stroke, instead of every other stroke, as in the single acting steam engine; and second, to the unscientific methods used in securing regulation.

It was the recognition of the above conclusions, that primarily led the Fuel Gas and Manufacturing Company's engineers, Mr. Albert Schmid (whose name is already well-known in the engineering profession) and Mr. J. Charles Bechfeld, to undertake the improvement of the valve gear and methods of governing found in the old forms of gas engine. As a result of years of experiment, they have devoloped an engine which is indisputably capable of giving a constant speed with exquisitely close regulation. Furthermore, they have incidentally introduced improvements which make the "Pittsburgh" motor, it is claimed, the most easy of access, the most self-contained, the most compact, and withal, the most efficient power generator on the market.

The illustration, Fig. 1, represents the first engine to crown with complete success a long series of experiments. It is presented as typifying the form of engine the company is now manufacturing in sizes from one quarter up to 200 brake h. p. Fig. 2 illustrates one of the "Pittsburgh" 100 h. p. engines, coupled direct to an electric generator, which it runs smoothly and efficiently.

As the principles of design and operation are the same for all these engines, a brief description of a single one will embody the characteristics of the whole class. Its economy of space, its peculiar adaptability to certain vital improvements, and the growing demand for an upright engine, led the company to adopt the vertical type as their standard. Specifically, the most striking innovation, and one destined to mark an epoch in gas engine history, is the use of a crank chamber to enclose the running bearings and lower end of the cylinders. This chamber is filled almost up to the shaft with a mixture of oil and water, into which the crank shaft and connecting rods splash at every revolution, so as to completely deluge the bearings, piston and interior of the cylinders, thereby, not only affording copious self-lubrication but also supplying the hitherto unattainable jacket to the piston. Oil for the crank chamber is introduced through the main bearings, which are supplied from the only two oil-cups on the entire engine. A simple pipe connection with a city main supplies the necessary water. Another pipe, serving to carry off the overflow, is made—by means of a funnel head—to indicate the level of the lubricants in the crank chamber.

All the "Pittsburgh" gas engines are built with two cylinders on a single shaft, and, as usual, abnormal heating is obviated by the employment of water jackets. Each revolution made by the engine operates valves admitting the gaseous fuel alternately to one or the other cylinder. As the period of admission is controlled by a positive action, the crank shaft receives an impulse once each revolution, no matter what the load, but the energy of that impulse is predetermined by an independent piston valve.

In order that the maximum amount of energy may be developed by the explosion of the gaseous fuel, there is but one value that the relative amount of gas and air can bear to each other. This value has been determined by a prolonged series of chemical analyses, and the Fuel Gas and Manufacturing Company now design their measuring piston valve so that it shall always admit gas and air in their correct proportion for producing the maximum result, but at the same time vary the total amount of mixture directly as the work of the individual piston stroke.

By reason of this refined adjustment of the energy developed to momentary load, and by the unvaried use of fuel at its maximum efficiency, the "Pittsburgh" engine is enabled to develop a much greater amount of work per given unit of gas, than any other generator thus far brought out. Furthermore, as the shaft receives once every revolution, an impulse that is proportioned to its load, there is maintained a smoothness and regularity of speed which heretofore has not been conceived possible in a gas engine.

Another important departure in gas engine practice is disclosed by the automatic governor, which both regulates the speed and controls the admission of fuel to the cylinder. It is mounted upon the shaft, between the cranks, and, by direct connection between the eccentric rod and valve stem, insures an accurate and positive travel to the measuring slide valve. Though the essential features of the Pittsburgh governor have demonstrated their excellence by long continued use on the steam engine, the Fuel Gas and Manufacturing Company are the first to adapt them to the gas engine, and to so improve them as to secure the virtually perfect mechanism which automatically regulates the engines with an efficiency and precision that is as truly remarkable as it is satisfactory.

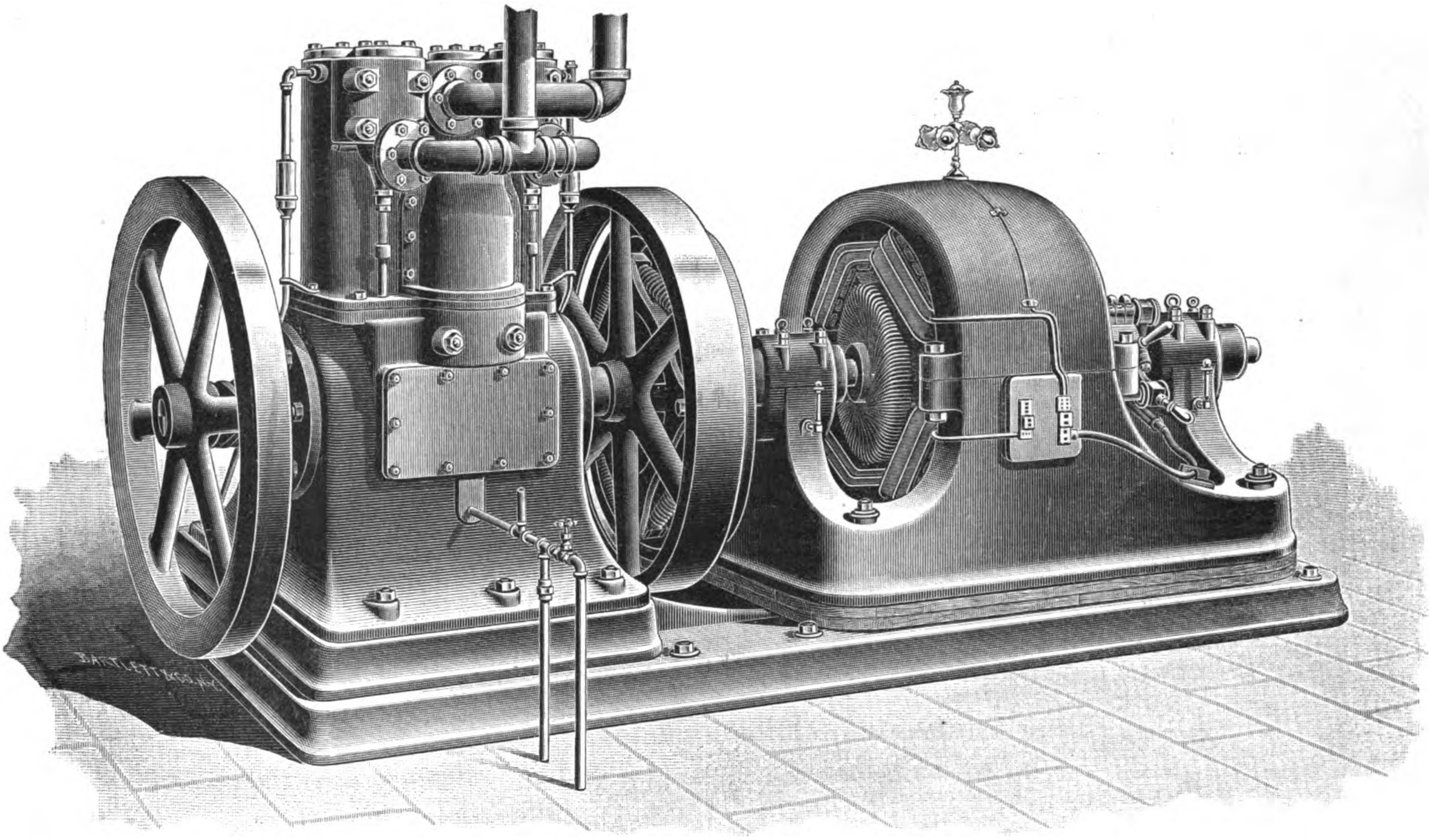
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FIG. 2.—THE PITTSBURGH GAS ENGINE DIRECT CONNECTED TO A RAILWAY GENERATOR.

The gas engine has developed three methods for igniting its fuel, viz., the use of a flame, a heated iron, and an electric spark. On account of its liability to blow out, the flame is gradually being discarded by the best manufacturers. The heated iron is more reliable, but clumsy and unsatisfactory. The electric spark is the most desirable device, provided there is no uncertainty as to its regularity of action. The Pittsburgh patent sparker consists, in brief, of an arm operated by a cam. At just the proper moment the arm is made to break an electric circuit, and the arc thus formed—intensified by the use of an induction coil—ignites the fuel instantly. As the arm is actuated by a positive motion, there can be no failure to produce a spark and no failure in the resulting ignition of the fuel. In order that the engine may be entirely self-contained, the electric current is supplied from a galvanic cell. If preferred, however, the requisite energy may be taken from a dynamo circuit.

In an article of this kind it is not necessary to mention at length all the details of the engine. It may be added that each is equipped with a moderately heavy fly-wheel, a band-wheel, where belting is to be used, the necessary gas bag, and all other minor but customary adjuncts. There remain, however, two or three general features of the "Pittsburgh" motor to which we must not fail to call attention. Though entirely self-contained, yet by reason of its simplicity of design and the distributive arrangement of parts, each detail of the engine is at all times readily and completely accessible. All stop-cocks and faucets are conveniently arranged on one side, within arm's reach of one another. The oil cups are supplied with a sight feed and so placed as to be easily accessible. Both at front and at back the crank chamber has large openings through which the shaft, governor rods, etc., may be reached by the loosening of a bonnet. The interior of the cylinders is similarly easy of access. The head is made removable, thus allowing ingress for an occasional cleaning out of the dirt resulting from gas combustion. By such construction any part of the engine may be removed in a very few minutes, and with no other trouble than that necessitated by the unscrewing of a few nuts.

As already intimated above, the Fuel Gas and Manufacturing Company have undertaken the manufacture of standard engines, which means that they are built strictly to gauge in every particular, thus allowing complete interchangeability of parts. In case of breakdown—which is a very unlikely occurrence, as only the best material and highest grade of workmanship in all construction is allowed—a duplicate part may be telegraphed for and secured with the least possible delay, thereby avoiding expensive repairs and a needless loss of time. The simplicity of the engine, the few wearing surfaces, and the copious lubrication, all tend to reduce the wear to a minimun, in fact, to such an inconsiderable quantity as to be almost negligible.

In order to substantiate the claims made for the "Pittsburgh" gas engine we give the following report of a test made by two competent and disinterested engineers. The engine used was of the latest design, rated at nine nominal brake horse power, having a 11-inch stroke and a piston 6 inches in diameter. (As will be noticed, contrary to the usual practice, the Fuel Gas and Manufacturing Company rate their engines by the *brake* and not the *indicated* horse power, *i. e.*, by the energy obtainable at the band-wheel, which is the only work of any engine available for the buyer.)

The test was made using city illuminating gas as a fuel. This is more expensive than common fuel gas, which nowadays is quite generally supplied through city mains or may be economically manufactured even on a small scale; but the company preferred to fulfill all the most exacting conditions, in order that any individual might decide for himself whether or not their engine was available for his own special conditions.

The duration of each of the three runs made, A, B, and C, was two hours.

	A	B	C
Load	Full	¾	0
Load on brake in pounds	75.8	52.6	0
Revolutions per minute	228.5	223.	221.

Pressure in pounds per square inch in cylinders.

		A	B	C
Mean Initial	Cylinder I	159.	103.	27.4
	" II	161.	104.	28.
Mean Terminal	" I	25.	18.8	8.8
	" II	25.3	19.	9.
Mean Effective	" I	61.	47.	17.
	" II	61.5	47.2	17.1

Indicated horse power.

	A	B	C
Cylinder I	5.38	3.59	.80
" II	5.40	3.62	.82
Total	10.78	7.21	1.62
Brake horse power	9.10	5.80	
Horse power loss in friction	1.68	1.41	
Mechanical efficiency	84%	80%	

Gas.

	A	B	C
Temperature, deg. centi	22.	16.	15.
Pressure in inches	1.5	2.	2.
Amt. in cu. ft., at 0°. C. consumed per hour	165.	121.8	50.
" " " " " per 1 h. p.	15.3	10.9	30.8
" " " " " " b. "	13.2	21.	

Water jacket.

	A	B	C
Pounds of water used per hour	1538.	1210.	1009.
Rise in temperature, degs. centi	220.2	19.	17.8

Samples of both the supply and the exhaust gases were sent to the "Pittsburgh Testing Laboratory" to be analyzed. From the results of the analysis reported by that firm, it was found that a cubic foot of the gas used in the test will, if completely burned, yield 434.3 B. T. units of heat. Though this is a very low value per cubic foot, it only indicates that the Pittsburgh gas is a much better illuminant than fuel, and does not in any sense favor the gas engine; on the contrary, it rather reduces the efficiency by the unavoidable heating of superfluous air.

With the conditions of the test as given, the energy received and expended per hour was divided as follows :

	A	B	C
Total energy received in foot pounds	55,200,000	40,800,000	16,750,000
" energy expended,			
indicated work in foot pounds	21,280,000	14,860,000	3.200,000
water jacket in foot pounds	23,900,000	17,800,000	1,382,000
exhaust, radiation, etc., in ft.lbs.	10,020.000	8,740,000	12,168.000
efficiency for I. H. P.	39%	35%	19%
" " B. "	33%	28%	

THE ELECTRIC LIGHTING PLANT OF THE "CORSAIR."

ONE of the most compact and efficient marine electric lighting plants which has thus far come under our notice is that recently installed in the new steam yacht, the "Corsair," owned by Mr. J. Pierpont Morgan, and illustrated in the accompanying engraving.

The plant which was designed by Mr. Robert Lundell, of the Interior Conduit & Insulation Company is a combination of two 15 k. w. dynamos and a 38 h. p. Willans' central valve engine. The novel features of the dynamos consist mainly in the design of the field magnets. They are of the four-pole type with inwardly projecting pole pieces, like the well-known Lundell motors. A single magnet coil magnetizes all the pole pieces; the keeper connecting the pole pieces forms an encircling shell, and makes the machine a true iron-clad.

The armature is a four-pole toothed drum, well laminated, and constructed for maximum efficiency. The openings around the armature at the ends of the field magnets are covered with metal screens to protect the working parts, and to secure at the same time perfect ventilation. The commutator portion of the armature alone projects outside the screen, and is well protected by a bracket which also forms the out-board bearing.

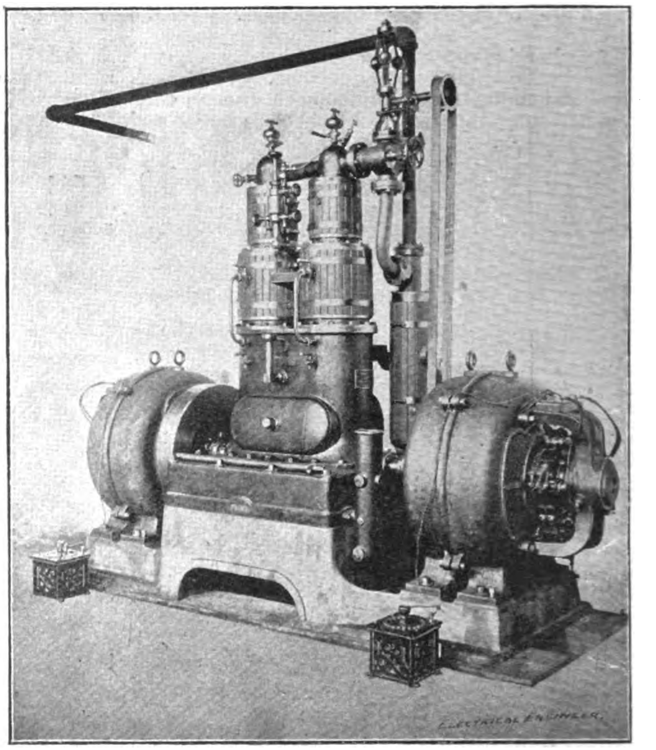
There are four brushes diametrically arranged around the commutator, the opposite brushes being connected together electrically. The brushes are independently adjustable, and also capable of being moved, all at the same time, around the commutator. They can also be raised from the commutator when the machine is not in use.

The machine, although plain shunt-wound, shows a drop in E. M. F. of only seven per cent. at full load, without the field rheostats being changed. It is so perfectly self-regulating that there is practically no need for compound winding.

All bearings are self-oiling, and the crank-shaft of the engine runs in a spray of oil. The floor space occupied by this plant is 85x32 inches, and the total height from the base of the bed-plate of the engine to the tip of the governor, is only 89 inches. The speed is 500 revolutions a minute, which is the standard speed of this style and size of engine. Although a comparatively high speed, the combination is perfectly noiseless, with absolutely no jarring, giving perfection of elegance for an isolated plant, where limited space is part of the inevitable.

A novel feature of the plant is that one dynamo is used to supply current direct to all the lights, and the other is used to charge storage batteries at the same time. When it is desired to use outside lights for illumination on gala occasions, the current from both dynamos is switched into the lighting circuit.

The entire plant was installed by the Interior Conduit Insulation Company. The dynamos were built in the shops of that company. The engine was imported, and is of the Willans' patent, manufactured by the well-known English firm of Willans & Robinson. It serves for a most interesting comparison with American methods and engines.



LUNDELL LIGHTING PLANT IN THE STEAM YACHT "CORSAIR."

MOISSAN'S EXPERIMENTS WITH THE ELECTRIC FURNACE.

Two further papers upon his researches with the electric furnace are contributed by M. Moissan, to the current number of the *Comptes Rendus*. In the first it is shown that crystals of quartz and zircon are almost instantly fused at the high temperature of a powerful electric arc, the liquids brought to vigorous ebullition in a few moments and actually distilled, passing over into the receiver in the form of a dense fume. M. Moissan further demonstrates how easy it is at this high temperature to obtain pure zirconium and pure silicon by reduction of the liquefied oxides with carbon. The current employed was one of 360 amperes. When fragments of rock crystal were placed in the crucible of the furnace and subjected to the arc they rapidly melted, and in seven minutes the liquid boiled vigorously; the vapor of silicon dioxide which escaped condensed in the cooler portion of the furnace to a bluish-white fume, which deposited in the receiver in the form of small opalescent spheres, visible to the unaided eye. These spheres of silica were solid throughout, and usually exhibited a depression at some portion of the surface, indicating contraction upon passing from the liquid to the solid state. They were readily soluble in hydrofluoric acid. It is of interest that M. Moissan has discovered similar opalescent spheres of silica upon glass globes which have been employed in electric lighting to diffuse the light from arc lamps, indicating that slow volatilization of the silica of the glass had occurred. It is doubtless to this cause that the opalescence which usually occurs after such globes have been in use for some time is due. The specific gravity of the spheres is 2.4, slightly less than that of quartz. At the temperature of the arc given by 360 amperes, liquid silica is very readily reduced by carbon, a crystalline regulus of silicon being obtained containing more or less carbon.

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World's Fair Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue Boston, Mass.
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THE GAS ENGINE IN ELECTRIC LIGHTING.

THE great variety of purposes to which electric current is applied at the present time has served to force into prominence the enormous influence of the nature of the power plant on the economy of operation; and those who have followed the trend of modern practice have been impressed with the change which has come over the methods formerly considered as standard. While steam engineers in the beginning were concentrating their attention upon the best means for securing accurate regulation they often failed to recognize the equally important—and, from the standpoint of the stockholder, vital—need, of the best arrangement for obtaining the highest economy in consumption of fuel and kindred expenses for power generation. It was only after the flush of the first success in the introduction of electric lighting, and, we may add, upon the appearance of competition, that the economies long practiced in other fields involving the application of power were found to be necessary to financial profit. It is not our intention here to enter into the history of the changes which the recognition of those facts brought about; they are already familiar to our readers and our pages are constantly chronicling them. But there is another aspect to this question of economy in power generation which, it would appear, has yet to be brought to full recognition, but in respect to which there are even now sufficient data at hand to furnish fairly safe conclusions. We refer to the employment of the gas engine as a prime mover for driving current generators. Not a few such engines are already in use in central stations where, as a rule, the electric plant is an adjunct to a gas plant, but for isolated electric lighting the gas engine has made but comparatively little progress. It seems opportune therefore to inquire into its present status, and to consider some of the more recent developments with a view to ascertaining the direction of its probable future in this field.

In some estimates recently made by Prof. Kennedy it was shown that the engine room cost per unit (1,000 kilowatt-hours) generated by the Westminster Company in London was 2.2 cent. Almost simultaneously with this announcement we are given the results of an experiment extending over two years made in order to determine the cost of electric lighting with dynamos driven by gas engine in an isolated plant. The result showed that with gas at 68 cents per 1,000 cub.-feet, the cost of gas was 2.2 cents, per unit generated, while the total cost, including attendance, interest and depreciation came to 6 cents per unit, which showed a saving of over 12½ per cent. per annum. While the latter result leaves no doubt as to the economy of the gas engine in isolated plants even at the present cost of gas, the apparent disparity in the cost shown between the isolated plant and that of the central station per unit is easily explained when we consider the difference in the cost of gas to the consumer and its actual cost of manufacture. It goes without saying that a large central station operating gas engines would have its own gas generators, and with the present improved methods, it is claimed, producer gas can be manufactured at less than 10 cents per 1,000 cub.-feet. Under these conditions the reduced cost of gas would bring down the figures close to those of the steam plant. But while this may still be considered as a problem for the near future, the immediate application of the gas engine to sub-station work is receiving attention and we note as significant the recent installation of four gas engine sub-stations in Liverpool, in preference to converter sub-stations.

The most recent progress in gas engine economy, which we chronicle in another column, and which it is claimed, brings down the gas consumption to 13.2 cubic feet per indicated horse-power per hour, must also act as a powerful influence in gaining for this type of prime mover a more general recognition as an adjunct to electric generating apparatus. While as yet the large power units now being adopted have not been carried out in gas engine work, the tendency towards increase in the size of the latter is a constant one, and while 200 h. p. may be considered large for a gas engine unit to-day, it by no means follows that such will be the case five years hence. On the other hand, the instances in which units greater than this can be economically employed, form but a small minority still in central station work. Taking into consideration all these factors, therefore, the outlook for the gas engine in electric lighting seems favorable to its more general adoption, and we shall look forward with much interest to the experiment above cited about to be undertaken in Liverpool.

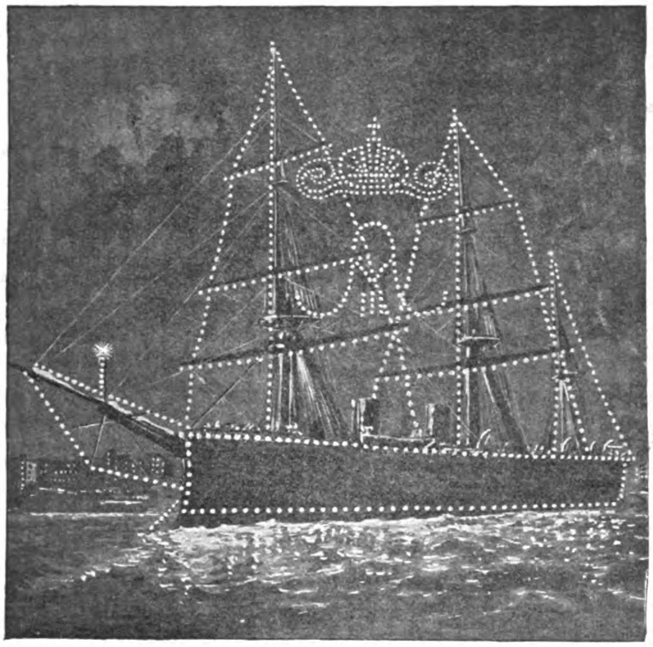
The remarkable result in gas engine economy above referred to, it is gratifying to know, is due to Mr. Albert Schmid, whose genius as a designer is already indelibly stamped on American dynamo electric machinery and whose ability as an engineer should leave little doubt of the future success of his latest improvement in engines for driving electric generators.

ELECTRIC ILLUMINATION OF THE RUSSIAN WAR SHIPS.

THE decorative illumination of war vessels by means of small incandescent lamps was a feature introduced with great effect during the recent Columbian celebrations in New York, and the beautiful scene at night when the British vessels were outlined in light against the black background of the night was not the least attractive part of the famous naval display.

The occasion of the birthday of the Czarowitch gave the Russian Admiral a chance to distinguish himself also, and to offer to the expectant public a view of his vessels at once beautiful and effective. The accompanying engraving gives some idea of the illumination of the "Dmitri Donskoi." The vessel was outlined in lamps from truck to water line, while between the masts was suspended a brilliant reproduction of the initial letter of the reigning Romanoff's name surmounted by the Russian imperial crown formed of scintillating lamps of different colors. In the position on the bowsprit usually occupied by the "Jack" gleamed a small bright star. The "Rynda's" decorations consisted of the crossed Russian naval and American flags surmounted by a five-pointed star.

The work was done by the Lamp Department of the General Electric Company under the immediate supervision of Messrs. G. C. Baillard and C. A. Gundaker, while Lieut. André de Petrowsky of the "Dmitri Donskoi," himself a skilled electrician, lent valuable aid in effecting the installation.



ELECTRIC ILLUMINATION OF THE RUSSIAN WAR SHIPS IN THE HUDSON.

TRIPS OF THE ACME STORAGE CAR IN NEW YORK.

FROM time to time we have recorded runs made by the Acme storage battery car, equipped with the McDougall system, on the Ninth avenue and Boulevard roads. As a matter of fact, the car is in constant operation, so that the set of batteries in use has had plenty of work with which to test its stability. On Thursday last, however, the car was taken over the whole stretch of the Boulevard line from West Sixty-Fifth street to the Fort Lee Ferry at the foot of Manhattan street and the end of Riverside Drive; making a total run of about nine miles. This it accomplished with wonted ease and success, but the noteworthy point of the trip was the ascending the long grade from Manhattan street up to the southern end of the Bloomingdale Asylum grounds, a distance straight up hill of about five-eighths of a mile, the grade being about 4½ per cent., if not more. The output for this work, by the Weston voltmeter and ammeter in circuit did not quite reach 27 h. p. for the few seconds of heaviest pull. After that the car took advantage of a clear, though not smooth track for the return run, and flew into the home stretch at a gait of not less than 15 miles an hour, with the batteries holding up their voltage in a very creditable manner. With such exhibitions going on, on both the west and east sides, it is a mystery of mysteries to us why New York City cannot have storage battery cars by the dozen.

HOW TO FIGURE ON LIGHTING A GIVEN SPACE.

IN answer to an inquiry of a correspondent, the *Architects' Electrical Bulletin*, issued by the Interior Conduit & Insulation Co., gives the following:

The number of incandescent lamps required to illuminate a given space is arrived at from a computation of the square feet of flooring, allowing one lamp to so many square feet, according to the kind of illumination required.

On this plan it is presupposed that chandeliers are employed, and not ceiling work. Chandeliers should depend from the ceiling uniformly at a distance of about seven and one half feet from the floor in order to get the best results. At this distance it is correct to allow one 16 c. p. lamp to forty square feet for excellent lighting; for good lighting it is customary to allow one 16 c. p. lamp to sixty-four square feet, and for general illumination, one 16 c. p. lamp to one hundred square feet of floor.

In ceiling work which is becoming more and more popular where expense is not considered, lamps may be used ad libitum. In this kind of work no rules can be observed, as height of ceiling, color of decorations, effect intended, and many other things may be taken into account by the artist.

The candle power of arc lights is so variable that their use is limited to big spaces, and the best result from any given light is simply a matter of experiment, and cannot be arrived at by any rules at all. In regard to the cost of the installation of the Interior Conduit system, including wire and labor, it is safe to say that a fair average is $8 a lamp. This does not include fixtures.

DISCHARGE THROUGH GASES.

A PAPER was read recently before the Royal Society by Prof. J. J. Thomson, F. R. S., on "Electrolysis of Steam," in which the repeated discharge of electricity through gaseous matter, noticed as ribbon flashes in lightning, is thus explained: "When an electric discharge passes through a gas, the properties of the gas in the neighborhood of the line of discharge are modified. Thus, as Hittorf and Schuster have shown, the gas in the neighborhood of the discharge is no longer an insulator, but can transmit a current under a very small potential difference. Faraday's remark, that when once a spark has passed through a gas the passage of another following immediately is very much facilitated, is another example of the same thing. We have thus good reasons for believing that when a spark passes through a gas it produces a supply of a modification of the gas, whose conductivity is enormously greater than that of the original gas. I have shown (*Phil. Mag.*, November, 1891) that the conductivity of this modified gas is comparable with that of strong solutions of electrolytes. When the discharge stops, this modified gas goes back to its original condition. If now the discharges through the gas follow each other so rapidly that the modified gas produced by one discharge has not time to turn to its original condition before the next discharge passes, the successive discharges will pass through this modified gas. If, on the other hand, the gas has time to revert to its original condition before the next discharge passes, then the discharges pass through the unmodified gas. We regard this as being accomplished by means of successive decompositions and recombinations of its molecules, analogous to those which, on Grotthüs's theory of electrolysis, occur when a current passes through an electrolyte."

COLLEGE NOTES.

ELECTRICAL ENGINEERING AT JOHNS HOPKINS UNIVERSITY.

THE JOHNS HOPKINS UNIVERSITY Register for 1892-93 gives details of the course in electrical engineering now pursued at that University. Instruction is given by Dr. Louis Duncan, Associate Professor of Electricity; Mr. Hermann S. Hering, M. E., Associate in Electrical Engineering, and Mr. Francis Head, M. E., Instructor in Mechanical Engineering.

The course extends over two years, and is primarily intended for graduates, but special students are admitted on passing certain examinations. The instruction includes lectures in theoretical and applied electricity with constant laboratory work. During the first year lectures are devoted to the physical and mathematical theory of electricity, while, during the second year particular attention is devoted to the theory and design of dynamos and motors, transmission of energy, electric traction, telephones, telegraphs, alternating current apparatus, etc. The students are expected to spend all their available time in laboratory work, the minimum time allowed being 8 hours per week. In addition to the purely electrical part, steam and hydraulic engineering, machine design and mechanical drawing is made part of the course with all essential factors in the equipment of an electrical engineer.

NEW CARPENTER ENAMEL RHEOSTATS.

Among the things heretofore inseparably connected with the switchboards of electric lighting plants and in general with motors, were the more or less cumbrous rheostats. These necessary adjuncts frequently occupy considerable space, and as heretofore constructed have always been looked upon with more or less disfavor by fire underwriters. It seems, however, that both on the score of compactness and of safety a revolution has been inaugurated by the introduction of "enamel" rheostats.

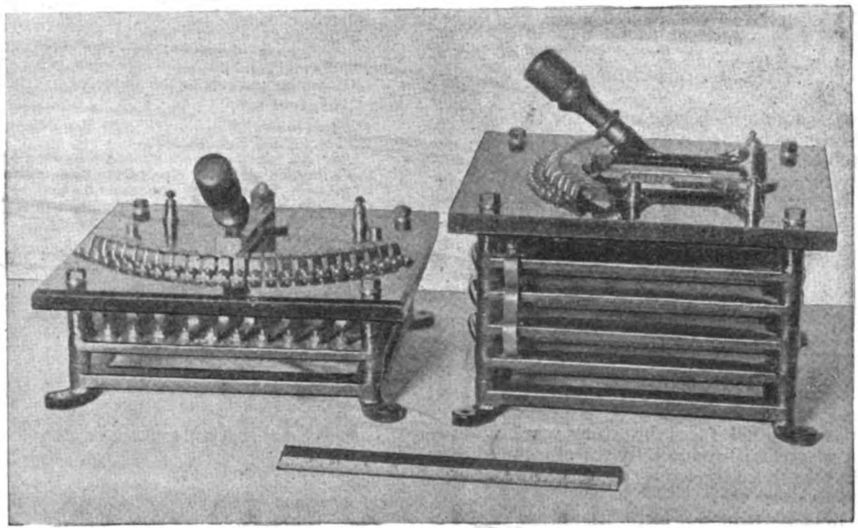


Fig. 2.—Enamel Rheostats for 5 K. W. and Over.

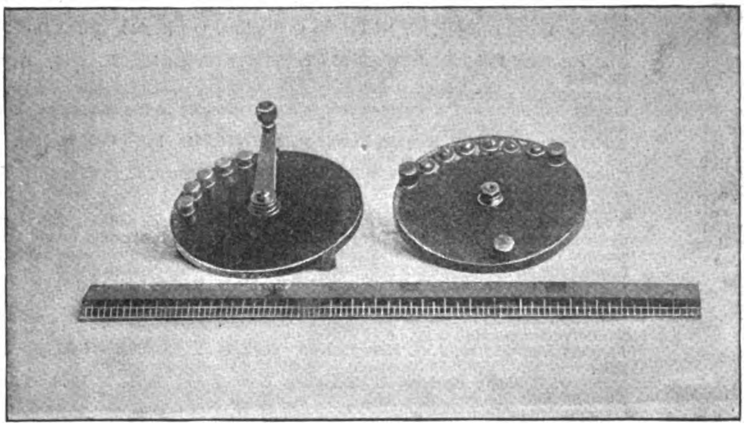


Fig. 1.—Fan Motor Regulator.

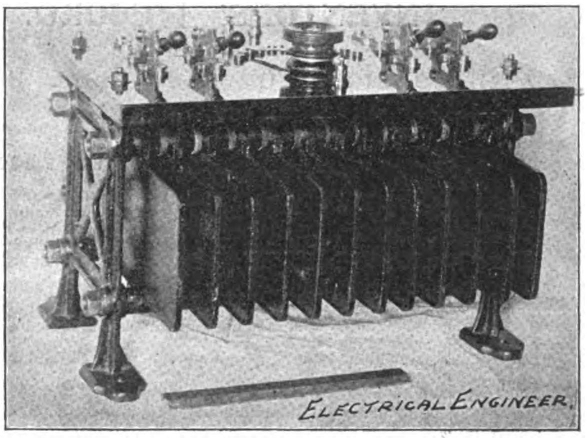


Fig. 3.—Compound Enamel Rheostat for McGill University.

The principle adopted in their construction consists in the conduction and dissipation of heat by holding a resistance wire in intimate mechanical contact with a supporting plate, so that the heat generated in the resistance wire, by the passage of a current, is rapidly conducted to the plate, which becomes the radiating surface. This is accomplished by the use of enamel, which attaches the wire to, but insulates it from the radiating surface plate, and which also completely surrounds the wire and protects it from chemical action. In this way the capacity of a resistance wire for current is greatly increased. In practice it is found that a wire that will carry a certain current when exposed to the air, will carry ten times that amount of current safely in an enamel rheostat. On this principle, since the cross-section of the conductor can be greatly reduced, it follows that its length can also be proportionately shortened for any required resistance, and no consideration of mechanical strength of the wire enters into this construction since it is so perfectly protected and supported on all sides. For example: A No. 20 B. & S. German Silver wire will, in such a rheostat, carry 25 amperes, and 30 feet of the wire coiled upon the surface of a plate 10 x 10 inches, will absorb and dissipate

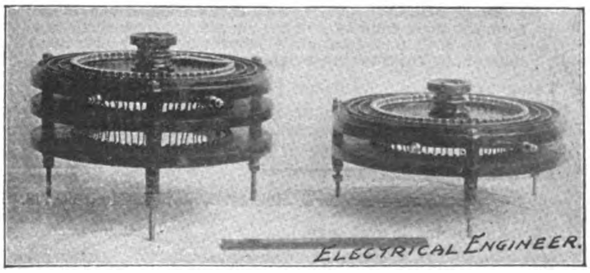


Fig. 4.—Field Rheostat for 100 K. W. Machine.

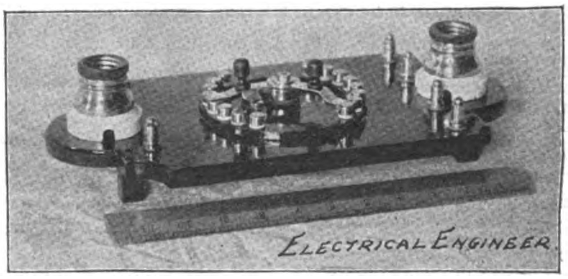


Fig. 5.—Rheostat for Dental Motors.

five kilowatts of energy in starting a five-kilowatt motor of 220 volts under full load.

We have already described a variety of rheostats of this type manufactured by the Carpenter Enamel Rheostat Company, of Bridgeport, Conn., and are now enabled to present to our readers some additional developments in this promising line of work. Among these is a small regulator, Fig. 1, for fan motors having from $\frac{1}{16}$ to $\frac{1}{4}$ h. p. By the aid of this little rheostat five different speeds can be obtained. When used in connection with motors above five kilowatts, the rheostats, in order to avoid the use of large plates, are built up of a series of smaller ones, the general appearance of which is shown in Fig. 2.

Fig. 3 shows a special rheostat which was made for the McGill University and is what might be termed a compound rheostat. It has a total resistance of 100 ohms with graduated steps, the first coil being capable of carrying continuously ten amperes and having 11 ohms resistance, the current capacity decreasing as the resistance increases. The rheostat portion of this apparatus is contained in eight of the plates shown which communicate with the button switch mounted on the centre of the slate switch base. There are combined also in the apparatus four independent coils, each capable of operating in parallel with the other and each having 11 ohms resistance, so that when placed directly across 110 volt terminals, ten amperes would pass through each coil or section. Two of the plates on each end of the resistance form this group of four plates, each one controlled by the knife switches shown.

This special rheostat was designed for laboratory work where it is desired to have an apparatus with which, by the combined use of the rheostat and coils in parallel, almost any amount of current can be obtained for one to 40 amperes.

Fig. 4 shows a form of field rheostat for large machines of over 100 k.w. All field rheostats are made disc shaped, and for machines smaller than 100 k. w. they consist of one plate, with contact buttons arranged in a circle like those of the larger sizes. These rheostats are made of two or more plates arranged in tiers one above the other as shown.

Fig. 5 shows a special rheostat made for the S. S. White Dental Company, for regulating dental motors.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JUNE 20, 1893.

Accumulators :—

Secondary Battery, F. O. Norton, Oroville, Cal., 499,848. Filed May 26, 1892.

Claim 1 follows:

In a secondary battery, a cylindrical vessel closed at top and bottom, metallic battery discs or plates arranged within the top and bottom of said vessel and connected with the battery wires, a hydrated alkaline oxide within said cylinder in contact with one of said plates and an anhydrous metallic substance adjacent to the hydrated oxide and contacting with the other metallic disc or plate.

Alarms and Signals :—

Electric Alarm Money Drawer, W. J. Walker and A. L. Bedford, St. Louis, Mo., 499,864. Filed Feb. 17, 1893.

Electric Bell, W. J. Murdock, Boston, Mass., 500,027. Filed March 18, 1893.

Clocks:—

Secondary Electric Clock, R. S. Howland, Providence, R. I., 499,737. Filed Jan. 4, 1893.

Distribution :—

Electric Converter, G. Pfannkuche, Exeter, N. H. and A. Pfannkuche, Cleveland, O., 499,852. Filed May 13, 1887.

Claim 1 follows:

In an electric converter the combination of a primary conductor with a secondary conductor of magnetic material arranged to enclose or nearly enclose the primary, whereby it constitutes a magnetic envelope for the lines of force.

Dynamos and Motors :—

Regulator for Electric Motors, G. H. Whittingham, Baltimore, Md., 499,769. Filed March 24, 1892.

For protecting the armature when the current is shut off and suddenly turned on again.

Lamps and Appurtenances :—

Stand for Electric Lamps, J. Cathrein, Innsbruck, Austria-Hungary, 499,908. Filed Feb. 15, 1893.

Mode of and Means for Renewing the Filaments of Electric Incandescent Lamps, G. A. Frei, Springfield, Mass., 499,916. Filed Nov. 14, 1892.

Electric Lighting System, C. L. Morey, Centralia, Ill., 500,026. Filed Feb. 11, 1893.

A "system" for late home comers on dark nights. By its aid they may perhaps find the key-hole of the front-door.

Incandescent Electric Lamp, E. E. Cary, Boston, Mass., 500,053. Filed April 7, 1893.

Claim 1 follows :

An incandescent lamp consisting of a glass globe having a neck, a fusible cement in the neck for rendering the globe air-tight, and a silver-coated reflecting disc adapted to prevent the radiant heat of the filament from softening the cement.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 500,075. Filed April 1, 1893.

Claim 1 follows :

In an incandescent electric lamp, a fusible cement, supporting the leading-in wires, and rendering the lamp air-tight, composed of a granular substance, as sand, and a fusible matrix.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 500,076. Filed April 3, 1893.

Relates to the class of lamps in which the neck is closed and the leading-in wires supported by a fusible cement plug.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., and E. E. Cary, Boston, Mass., 500,077. Filed April 5, 1893.

Relates to the same class of lamps as the next above, and consists in a device for preventing leading-in wires from transmitting heat into the fusible cement plug.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 500,078. Filed April 5, 1893.

Similar to the next above.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 500,079. Filed April 7, 1893.

Of similar purport to the above.

Metallurgical :—

Production of Alloys by Electro-Deposition, C. R. Fletcher, Boston, Mass., 499,726. Filed Feb. 18, 1892.

Passes a current, from separate anodes of the several metals to enter into the alloy, through an electrolyte to a cathode, and so moves the cathode as to present its surface successively and repeatedly to receive the deposit from the several anodes. Produces brass by the deposition of copper and zinc.

Metal Working :—

Electric Bath Metal Heating Apparatus and Process, G. D. Burton, Boston, Mass.. and E. E. Angell, Somerville, Mass., 499,964. Filed Dec. 31, 1892.

Claim 1 follows :

The art of heating metal, which consists in subjecting it to the action of a stream of conductive liquid and an electric-heating current passing through the liquid.

Miscellaneous :—

Desk Switch, D. J. Willis, New York, N. Y., 499,770. Filed Nov. 30, 1892.

Means for Storing and Supplyng Electrical Energy by Natural Force, F. G. Corning, New York, N. Y., 499,708. Filed Nov. 14, 1892.

Employs a wind mill to charge a storage battery while a boat is at anchor, or at other times.

Phonograph, T. A. Edison, Llewellyn Park, N. J., 499,879. Filed July 30, 1888.

Relates to details of construction of the phonograph and to the connections of a driving electric motor.

Electric Stop Mechanism for Knitting Machines, F. Hammond, Paris, Canada, 499,921. Filed Jan. 9, 1893.

Electric Cut-Out, O. F. Persson, Lynn, Mass., 499,930. Filed May 1, 1893.

Automatic Electric Weighing Scale, C. F. Wood, Richmond, Va., 500,045. Filed Aug. 30, 1892.

Electro-mechanical device for lifting the door of a hopper.

Railways and Appliances:—

Electric Railway Grade Crossing Device, J. B. Stewart, Haverstraw, N. Y., 499,805. Filed August 26, 1892.

Relates to signals at grade crossings. Provides for preventing simultaneous safety signals on both tracks.

Trussed Trolley-Board for Electric Cars, H. Cochran, Chester, Pa., 499,871. Filed Jan. 16, 1893.

Trolley Wire Hanger, L. Spillman, Columbus, O., 499,943. Filed Jan. 21, 1893.

Electric Road Vehicle, J. W. Moakler, Denver, Colo., 500,023. Filed April 16, 1892.

Adapted to a road vehicle or to a locomotive for drawing cars. Consists mainly in the use of a worm-screw fastened directly to the armature shaft and gearing to the axle.

Electric Signal, G. W. Swartz, Florence, Ala., 500,041. Filed Oct. 31, 1892.

For use on railroads.

Closed Conduit for Electric Railways, J. C. Henry, New York, N. Y. 500,065. Filed Sept. 8, 1890.

Claim 1 follows :

In an electric railway, the combination of contact boxes at intervals along the roadway, an armature projecting through each box and a temporary magnet carried by the car adapted to raise said armatures above the surface of the street and make magnetic and electric contact with them.

Electric Locomotive, J. C. Henry, New York, N. Y., 500,066. Filed Oct. 18, 1890.

Duplicates the circuits so that in the event of accidental crosses or grounds the defective portion may be switched out.

Electric Locomotive, J. C. Henry, New York, N. Y., 500,067. Filed Dec. 16, 1891.

Electric Railway System, J. C. Henry, New York, N. Y., 500,068. Filed April 29, 1892.

Relates to railways on which cars are operated in trains, and aims to distribute the motive power and traction over all the cars, while confining the contact devices to a single car.

Power Transmitting Mechanism, J. C. Henry, Westfield, N. J., 500,069. Filed April 29. 1892.

Relates particularly to transmitting power from a motor to the driving axle of a car.

Electric Railway Trolley, J. C. Henry, Westfield, N. J., 500,070. Filed Sept. 3, 1890.

For overhead wires. See page 625 of this issue.

Electric Railway System, C. J. Reed, Orange, N. J., 500,104. Filed June 27, 1892.

Relates to a conduit system, and employs a storage battery on the car. Includes switching devices whereby, whenever the motor is disconnected from the main conductor or conductors different sections of the storage battery are cut into and cut out of circuit and the motor caused to take its current wholly from the storage battery.

Telegraphs :—

Telegraphy, P. J. Wicks, Brooklyn, N. Y., 499,811. Filed March 3, 1893.

Adapted to quadruplex and duplex systems. Provides means for avoiding false signals in the neutral relay.

Telephones and Apparatus :—

Telephone Exchange, A. E. McClaren, Joplin, Mo., 499,748. Filed June 13, 1892.

An automatic exchange.

THE JENNEY ELECTRIC MOTOR CO., of Indianapolis, Ind., have issued a pamphlet entitled : "The Standing and Record of Jenney Apparatus." It contains a long list of purchasers of their motors and generators, and prints in fac simile a thick wad of testimoinals as to the durability, efficiency and economy of their machines of all sizes and classes. The pamphlet is also adorned by some cuts of the Jenney motors and dynamos.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE PACKARD SIX CANDLE POWER LAMP.

APPRECIATING the demand for a small lamp for ornamental, advertising and special purposes that will compare favorably with the regular 16 c. p. commercial lamps in efficiency and life, the New York and Ohio Company, the manufacturers of the celebrated Packard lamps, are placing upon the market something new in the 6 c. p. lamp represented in the cut below. The lamp is similar in every respect to their regular commercial lamp and has approximately the same efficiency and life. The lamp is mounted to fit any standard socket and any of the regular low voltages such as 50 or 52-volt. Where they are burned on a higher voltage they should be wired two in series. The special feature which recommends the lamp is the fact that the filament is burned at the same degree of incandescence as that of a regular lamp, thus giving a uniform life and light. The advantage of a lamp of this kind for special purposes will be appreciated by any one who has been compelled to use miniature lamps for such purposes.

PACKARD SIX CANDLE-POWER LAMP, FULL SIZE.

The Electric Appliance Company are Western agents for the New York and Ohio Company, and are furnishing these lamps in the West, and are themselves giving them a thorough test in their World's Fair exhibit where they have over five hundred burning in their illuminated lamp sign. The effect produced by their use in this particular case gives some idea of the extensive field they will undoubtedly help fill as soon as their particular merits are appreciated by the trade.

ELECTRICAL PLANT IN A DENVER SMELTER.

MESSRS. SHEPARD & SEARING, mechanical and electrical engineers of Denver, Col., have just completed the plans for the new lighting and power plant for the Omaha and Grant Smelter, of that city. The smelter has been erecting a new engine, boiler and blower plant with a view of doubling its present capacity, and at the same time centralizing all its machinery in one building, all the smaller engines for driving crushers, hoists, fans, etc., being replaced by 500-volt electric motors operated by generators in the main blower room.

The capacity of the arc and incandescent plant will also be doubled. The whole electric plant when complete will consist of two 25-light arc machines, two 200-light incandescent machines, and two 65 h. p. generators, driven from a countershaft by the L. P. & D. system of transmission. The countershaft will be driven from the main blower shaft by rope belting having a capacity of 250 h. p. The use of the above systems were necessary on account of the limited space. The whole plant including countershafting, reserve engine, switchboards and free space around machines occupies only 24 ft. by 43 ft.

One incandescent and one arc machine are so arranged that in case of a break down of the main driving power, they can be run from a separate high-speed engine installed for the purpose, and the circuits are so planned that by throwing two switches on the board, all the lights, either arc or incandescent, needed at such times will be operated by these machines. The switchboard is to be of slate set in an iron frame, and divided into sections for the different systems.

As soon as the smelting furnaces can be changed over and operated from the new blowing room, it is intended to operate the slag cars running from the furnaces to the dump by an electric locomotive, thereby displacing five mules.

Messrs. Shepard and Searing, it is worthy of note, are the only engineers in Denver doing a strictly engineering business on a percentage basis, using only the best methods and best apparatus irrespective of particular systems or manufacturers, and have earned for themselves an excellent reputation,

"PUMPS AND HYDRAULIC MACHINERY."

THE GOULDS MANUFACTURING COMPANY, of Seneca Falls, N. Y., have just issued a new catalogue entitled: "Pumps and Hydraulic Machinery," which is worthy of more than ordinary note.

This catalogue is designed as a general, though not complete catalogue and anticipates the publication of a book covering their entire manufacture which to-day embraces such varied styles and is adapted for such different trades that they have followed the plan of issuing special catalogues for special goods and trades. For instance, in addition to this book, they have a special book devoted exclusively to power pumps for every service; another to irrigating pumps, horse-powers and appliances; another to spray pumps, etc., etc.

A feature of this catalogue is its convenient size which will generally recommend it to the trade. Another important addition will be found in the tables, sizes, prices, etc., and "approximate weights." This is an item that will be heartily appreciated by parties estimating costs at a distance where freight is a considerable factor. It will also be noticed that in connection with each pump is given its limit working capacity, such as height, lift from surface of water to point of discharge, approximate speeds, etc., etc. This is an item that has never been included before in other trade catalogues of this class, and will make more easy the selection of goods for any place or duty.

ANSONIA ELECTRIC CO.

THE Wirt regulating switch used for dimming incandescent lights, particularly for use in bedrooms and nurseries seems to be particularly popular, as two different papers have written to the Ansonia Electric Co., the manufacturers, for electrotypes, as they wish to illustrate it in their papers, as a meritorious novelty.

The Ansonia Electric Co., report the sale of Wirt brushes to be on a steady increase, and heavy sales in Stanley moisture-proof transformers and Habirshaw wire. The Ansonia Electric Co. also report an enormous sale in Crocker-Wheeler motors, especially in the fan type.

COST OF HEATING CARS ELECTRICALLY.

IN our issue of May 10 some figures were given showing the cost of heating cars electrically, as determined in an exceedingly interesting table recently issued by the Consolidated Car Heating Company, of Albany. Through an inadvertance the results given were stated in cents instead of dollars. We give the corrected statement of cost as follows:

With a station equipped with compound, high-speed non-condensing engines, with coal at $3 per ton the cost of coal per hour for heating the car with the switch in the first position, giving 2.14 amperes, is .00756 dollar; with the switch in the fifth position, taking 12 amperes, the cost is .04272 dollar.

The heater, however, is usually operated at the third position, which meets the requirements of an external temperature of 20 to 30 degrees Fah. and at that point the cost is .02472 dollar.

WESTERN NOTES.

"THE ELECTRIC SPARK" shines on with a radiance that is marvelous in view of the average mugginess and density of the Chicago atmosphere. It is with regret that we note, however, in the June issue, Mr. David Goe's "vale." We can only hope that the paper will have as much "go" as ever, but we fear it will not, unless he contributes under some nom-de-plumage, lending it a little of his own airy wit and lightness of humor. Goes are rarely born and never made, and the cleverness of this one has been to the funniness of the ordinary paragrapher as the ether of interspace is to the air in a Wabash avenue subway.

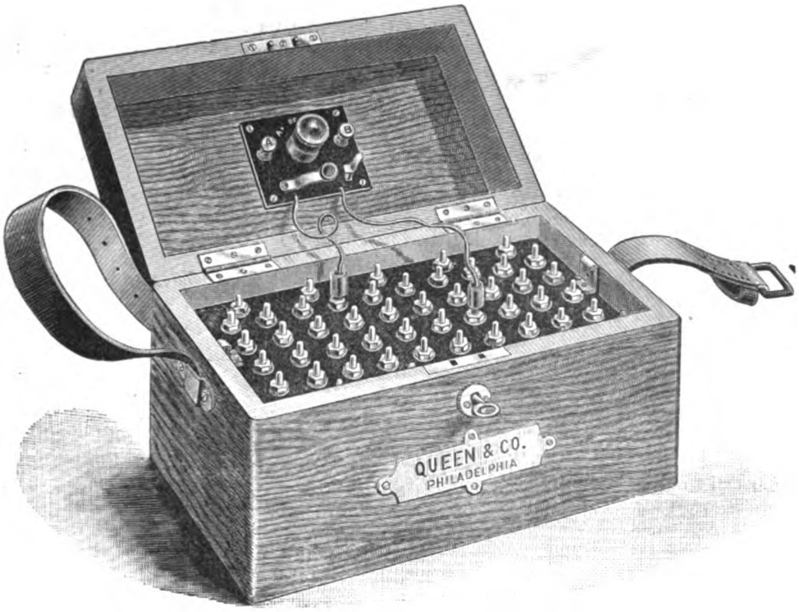
THE "ALUMINUM-IODINE" PORTABLE TESTING BATTERY.

THE testing battery illustrated herewith is a new form that has been thoroughly developed in the experimental department of Queen & Co., Incorporated, Philadelphia, and is now placed on the market by this company with expectation of a large demand.

In chemical composition the "Aluminum-Iodine" cell is quite different from anything heretofore known, and possesses important features, the most essential of which is electromotive force. Each one develops a voltage of $1\frac{1}{10}$ volts, which is fully 50 per cent. more than the output of an ordinary "chloride of silver" cell. The effect, as will be seen, is that 50 aluminum silver cells have the same efficiency as 75 of the other type, so that great economy in first cost results.

The cells are prepared with great care, and those used in the laboratory of Queen & Co., for months past, have shown remarkable constancy and long life. There is no danger of explosion or leakage, and local action is practically eliminated, so that when not in use there is no injurious waste.

The cells are mounted in handsome polished mahogany cases in sets of 50, more or less, as desired. A battery of 50 cells gives 70 volts E. M. F., which is quite sufficient for all ordinary work. Electrical engineers in testing the insulation of submarine or underground cables often require 200 or 300 volts to secure proper sensibility in results, and a battery of as many cells can readily be prepared if desired.



"ALUMINUM-IODINE" PORTABLE TESTING BATTERY.

The "Acme" portable testing set also manufactured by Queen & Co., contains 12 "Aluminum-Iodine" cells, which they propose to use entirely in place of the regular "chloride of silver" form. Interested parties should write them for a copy of descriptive circular No. 445.

TESTING COAL BY ELECTRICITY.

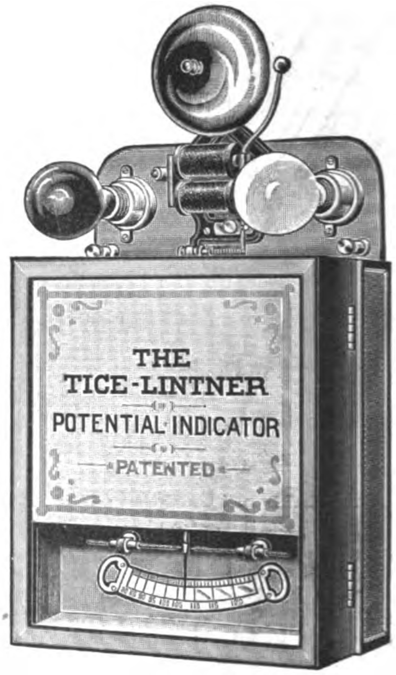
W. HEMPEL, one of the leading authorities on coal gas in Germany, has recently adopted a method, first devised in more complex form by Berthelot, whereby the sulphur in coals may be estimated, and hence their suitability for gas-making determined before purchase. In doing this he has taken advantage of the cosmopolitan aid which electricity offers. The coal to be tested is powdered and pressed into a little platinum wire cylinder, to which a long platinum wire is attached, and then burned. The combustion is effected in an ordinary glass bottle, which is fitted with a trebly perforated India rubber stopper. Through this passes a tube with a glass stopcock, and which widens out into a cylinder; also two glass tubes, to the lower ends of which are fused two long thick platinum wires. One of these wires carries the little platinum cylinder or basket already referred to. A little mercury is poured into the tube so as to establish sure contact with wires which carry the current. When the current is passed the platinum basket becomes white hot, the combustion of the coal is effected, and the gaseous products containing the sulphur compounds are led off through the stopcock and examined chemically. This method is exceedingly neat, and gives, it is said, very satisfactory results, which enable the character of the coal to be accurately determined.

STANDARD PAINT COMPANY.

THE above company, of No. 2 Liberty street, this city, have just issued a very neat little brochure devoted to their celebrated "P. & B." electrical compounds. The most effective part, perhaps, is that in which a large number of powerful testimonials are presented from users of these compounds, all over the country, including parent companies, local companies, wire and cable makers, dealers, supply houses, and city electricians. Varnish, tape, compounds, cloth, paper—all come in for words of praise; and we might well believe that "P. & B." stood for "proved" and "blessed" by everybody.

THE TICE-LINTNER POTENTIAL INDICATOR.

THE improved form of the Tice-Lintner potential indicator is shown in the accompanying illustration. The advantages accruing from close potential regulation are so obvious that it is unnecessary to dwell at length upon them. The Tice-Lintner potential indicator combines with a voltmeter of high accuracy, permanency and dead-beat qualities, an alarm attachment of equal reliability, which immediately attracts the attention of the attendant to any change or variation in pressure, and the trouble is remedied before any damage ensues to the lamps or motors on the working circuits. Aside from the alarm, the especial features of the instrument are the entire lack of permanent magnets, or any other deteriorating element, and the fact that it can be operated in the close vicinity of intense magnetic fields without disturbing the accuracy of its readings. A neat circular containing a full and complete description of the instrument is now being issued by the Tice-Lintner Electric Co., Minneapolis, Minn.



TICE-LINTNER POTENTIAL INDICATOR.

WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY promise to surprise the trade with some marked improvements in their Elkhart transformers in the way of a new fusing arrangement particularly adapted for circuits of 2,000 volts primary and also in a system of removable coils making it a very simple matter to repair an occasional burn-out. The sales of the Elkhart converter for the past year since the Electric Appliance Company took hold of it as general Western agents have been large, and it is now in use in nearly every part of the country. The improvements above mentioned have added materially to its merits and a very heavy sale for the coming Fall and Winter is expected.

THE NEW WARD SEARCH LIGHTS AND PROJECTORS.

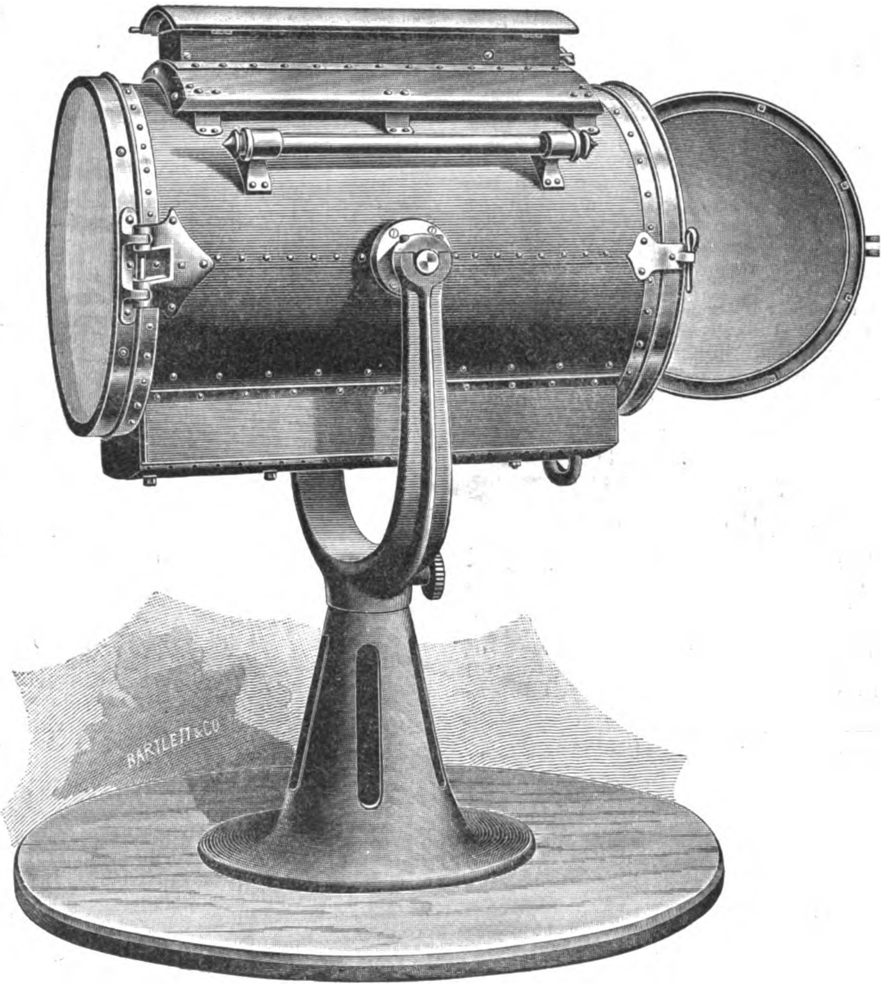
Although fully abreast, and, not infrequently ahead, of the best electrical practice known abroad, it must be confessed that in the matter of search lights and projectors, America has, up to the present time, been sadly behind Europe. While the projector with the celebrated Mangin reflecting lens has been brought to high perfection, we in this country have been confining ourselves almost exclusively to the old and uneconomical parabolic reflector, which could never compete with the former in power of concentration and clearness of definition.

In view of this state of affairs it is gratifying to know that through the enterprise of the Electric Construction and Supply Company, of this city, search lights with accurately ground Mangin reflecting lenses are now being regularly manufactured by that company, and our illustration shows the latest type of their projectors.

In the design of this apparatus simplicity of construction and ease of manipulation have been the points constantly borne in mind. The lamp is of the Ward focussing type, of exceedingly small dimensions, and mounted within the drum. It is so mounted that it can be slid bodily towards or from the lens. By this means the arc can be brought into absolute focus and a solid concentrated beam of light projected; or if it is desired to cover a greater area with light, the lamp can be moved out of focus and the beam spread out. By this simple method the use of the usual, expensive and easily broken dispersion lenses on search lights is obviated. A small wheel at the back of the drum permits of this lamp shifting.

The Mangin lenses employed on these search lights are all made in this country and hence at a greatly reduced cost over the imported ones, so that the total cost is very little greater than that of the old style silvered, metal reflector. These reflectors are so mounted that they can be maintained in perfect condition, requiring only the exposed surface to be kept clean.

The projector is made of brass and copper throughout, and can be revolved continuously in a horizontal plane in either direction. It can also be tilted up and down, the focussing arc lamp feeding at all the angles used in signalling. The drum is mounted on ball bearings so that the manipulation of the reflector requires scarcely any manual effort. A 12-inch projector of this type, highly finished in brass and copper, provided with automatic focussing lamp with pilot house attachment, etc., weighs about 125 pounds. Considering the durability and strength of the parts, this is an exceedingly small weight. We have had the pleasure of seeing one of these projectors in operation at the offices of the Electric Construction & Supply Co., at 18 Cortlandt street, this city, and were much impressed with its many excellent features. They are made in sizes to take from 5 to 100 amperes with both automatic and hand-feed lamps.



New "Ward" Search Light and Projector.

"INSTANTANEOUS" EXECUTION BY ELECTRICITY.

Describing one of the latest electrical executions the press dispatches from Dannemora, N. Y., say: "Martella was brought into the death chamber at 11:42 this morninimg. The first current, lasting one minute and eleven seconds, was for two seconds of 1,660 voltage. It was then gradually reduced to 150 volts. An examination of the heart was made by the physicians, and they agreed that the man was not dead. A second shock was administered for 55 seconds, first of full strength and gradually reduced as before. After a second examination of the heart the physicians pronounced the body lifeless." It would appear that d'Arsonval knew what he was talking about when he said that the current only numbed its victim.

A. A. A. S. MEETING.

The secretary of the American Association for the Advancement of Science has just issued the circular and programme of the 42d meeting of the Association, which is to be held in August at Madison, Wis. The circular gives full information relating to the details of the meeting including hotel accommodations, railway rates, etc. Section B, on physics which includes electricity, is presided over by Prof. E. L. Nichols, of Cornell University, New York, with Prof. W. Le Conte Stevens, of Troy, N. Y, as secretary. The meetings will be held in the rooms of the University of Wisconsin. The circular can be obtained from Mr. F. W. Putnam, permanent secretary, Salem, Mass.

THE MUNCIE ELECTRICAL WORKS.

In the last issue of The Electrical Engineer we illustrated and described the machine now being manufactured and placed upon the market by the above company, a short description of whose works, facilities and personnel, will no doubt be of interest to our readers. The city of Muncie is beautifully situated in the centre of the famous Indiana gas belt, and is one of the fastest growing towns of the Central States. Its wonderful growth in the past five years is due principally to three good reasons: 1st, its unlimited supply of natural gas which affords a class fuel at a ridiculously low price; 2nd, its railway facilities and, 3rd, its being so centrally located that manufacturers may use their railway facilities to excellent advantage in shipping goods to all parts. These were the principal points taken into consideration by the Muncie Electrical Works people. A number of cities were visited and factories and factory sites were investigated, with the result that after most careful consideration, Muncie, Ind., was decided upon as the best place to launch another manufactory of apparatus. This was done but a few months ago, and to-day we find a factory second to none in the country as regards building, machinery, equipment, location, and facilities for both making and shipping goods. Their splendid two story brick factory of modern construction, with a frontage of 160 x 60 feet, is situated in the very heart of the city and within easy distance of the railroads.

The factory has been newly equipped throughout with milling machines, planers, punches, lathes, in fact everything needed in a first-class manufacturing concern. This portion of the equipment was furnished entirely by Lodge & Davis. Every attention has been given to light, ventilation and sanitary arrangements in the factory.

The officers of the company are, first, Mr. F. A. Van Namee, president and treasurer, who, while not one of the old timers in the electrical business, has had a thorough business training with some of the largest manufacturing concerns in the country. Mr. James Chamberlain, who is general manager of the company, has had large experience in his particular line. Mr. F. C. Field, the electrical engineer, is well-known among electricians. Mr. Field is the inventor of the system, which by the way, the company was formed to introduce. He is a graduate of the Worcester, Mass., Polytechnic Institute, having been the Institute's youngest graduate, besides graduating with honors. While still a very young man, Mr. Field has had a large experience in the manufacturing of electrical apparatus, having held responsible positions with the Thomson-Houston Co., The C. & C. Electric Co., and the Detroit Electrical Works. Mr. Field has with him as assistant, Mr. F. W. Hild, a valuable acquisition to any company, for beside being a close student of the science, Mr. Hild is also a practical man, being a first-class mechanic with an immense faculty for getting things right.

The company so far have only been able to keep abreast of business on order, everything having been manufactured to fill contracts, but their facilities are now such that a large business can be done.

SYNOPTICAL INDEX OF CURRENT ELECTRICAL LITERATURE.

It seems to us that the end of the Nineteenth Century is making itself conspicuous as a great era of indexing. So much is said and done in any one department of human activity that unless some systematic effort is made to keep the run of things in a general survey, a great deal that is valuable and noteworthy is apt to escape attention. At the present time, there are various engineering indexes, the most meritorious of which, perhaps, is Galloupe's, or that of the *Engineering Magazine*. In the electrical field, a very good index is published in Germany, but unfortunately it lumbers along a year or two after date in a language which nobody reads for sheer pleasure. Probably, the best electrical index for all current purposes is that to which Mr. Fred DeLand is giving personal attention in his journal *Electrical Engineering*, which was started to treat only of the World's Fair, but has since widened its field on the sound basis that the electrical journals present a World's Fair every week, and every year. The June issue of *Electrical Engineering* contains about forty pages of DeLand's extract of electricity; and when a man has read it, he has, if we may mix metaphors, hauled in a good deal of slack on his current reading. Of course, if one is a student, he will go through all the articles mentioned in which he has an interest; and if he isn't a student he can fling all the titles with tremendous effect at some other dilettante. As a matter of fact, these indexes are a necessity of the times, and if a man reads The Electrical Engineer or any other paper, or all, he will do well to help his memory with an index such as Mr. DeLand provides.

Elizabeth, N. J.—The entire plant of the Suburban Electric Light Co. of Elizabeth, which supplies current to suburbs for miles around, was destroyed by fire on June 19, with a loss of $125,000. Much of the machinery was totally new; some of it had never been used. The work of restoration was begun immediately, and several of the circuits are already in operation again.

NEW ENGLAND NOTES.

The Pettingell-Andrews Company, of Boston, have again become cramped for room owing to the large increase of their business, and are now making extensive alterations in their present store, by which they will gain extensively in floor space. The old offices will be given up for store and selling purposes, and new offices built at the other end of the store, and entrance will therefore be obtained through another door, which up to the present time has always remained closed. The whole interior of the store will be changed, and much better facilities provided for the display of goods. A comfortable waiting room for the use of customers and friends will also be provided and everything done to make the store attractive and convenient. Even a larger stock of goods than they have hitherto had, will be carried, so that purchasers will be able to get anything in electric light or railway supplies at a moment's notice, and will have an opportunity of seeing the goods actually in stock before purchasing.

The New England Weston Electric Light Company, of Boston, have just completed the installation of the four Nantasket Beach steamers which have hitherto been illuminated by oil. Each steamer has a 110-volt 160-light United States dynamo which is driven by a Ball engine, by the usual method of belting. The work has been done in a thorough and workmanlike manner. Each dynamo has a slate switchboard equipped with the latest type of Weston station voltmeter with illuminated dial, and the necessary rheostat, all being in care of the engineer on board. The wiring is all concealed and carefully waterproofed throughout, and the lighting has added greatly to the comfort of the passengers on these popular boats. The names of the boats are the "Twilight," the "Governor Andrews," the "General Lincoln" and the "Nantasket," the "Mayflower" having had an Edison electric light plant installed when she was built about two years ago.

The American Circular Loom Company, of Boston, have just issued another complete catalogue and price list of their specialty of "canvas jacket" flexible wire cables and tubing which will be found convenient and useful in the hands of electricians. The cover is particularly noticeable from the fact that it is an exact imitation of their canvas jacket, and being so is practically indestructible. In this price list they draw attention to their latest product "Canvasite" which is a rubber highly insulated wire, protected by their well-known canvas jacket. This enables them to supply a wire which not only possesses the very highest insulating properties, but which is also able to withstand a great amount of abrasion and the very hardest of service.

Albert and J. M. Anderson, of Boston, have just issued a new catalogue of their electric light and electric railway specialties which will be found very complete and extremely convenient for reference by all electrical engineers and contractors. It embraces their usual line of insulators for arc light hangers, and for all kinds of trolley work, Ajax switches, Boston trolleys, clamps, track drills, etc., for which this house has established a well-merited reputation. The new pivotal trolley is also illustrated, which embraces several new and valuable features, and which has a number of advantages not hitherto possessed by the Boston trolley, as it can be swung completely around in a circle.

The W. S. Hill Electric Company, of Boston, have just issued a very handsome new switch catalogue, which is probably the most complete book of the kind in existence. It embraces every kind of switch used in electrical work and is handsomely illustrated throughout, having been compiled with Mr. Poor's usual care and painstaking accuracy. A number of new and special switches are also illustrated for various kinds of special work, and every electrician should at once procure a copy, as he will be sure to find in it some kind of switch particularly adapted to his special kind of work.

The Whitney Electrical Instrument Company, of Boston, in addition to the agency which they have had for the past year in the Electric Appliance Company, of Chicago, have recently established agencies with the following companies, so as to ensure prompter dealing and to get in closer touch with their customers and friends: Poole Electric Company, Lynchburg, Va.; Nowotny Electric Company, Cincinnati, Ohio; Geo. L. Colgate, New York, N. Y.; Toronto Electric Works, Toronto, Ont., Canada; T. W. Ness, Montreal, P. Q., Canada.

The Hawks Electric Company, of Boston, have closed a contract for the complete equipment of a new central electric lighting station at Woodstock, Vt., embracing a 1,000-light alternating dynamo, a water-power about three miles away from the town, using Victor wheels, made by Stillwell & Bierce, of Dayton, Ohio, and all the necessary pole and line construction for street and house lighting.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

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